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TRANSACTIONS

OF THE

New England

COTTON MANUFACTURERS' ASSOCIATION.

Founded April 20, 1865. Incorporated Dec. 1, 1894.

NO. 78.

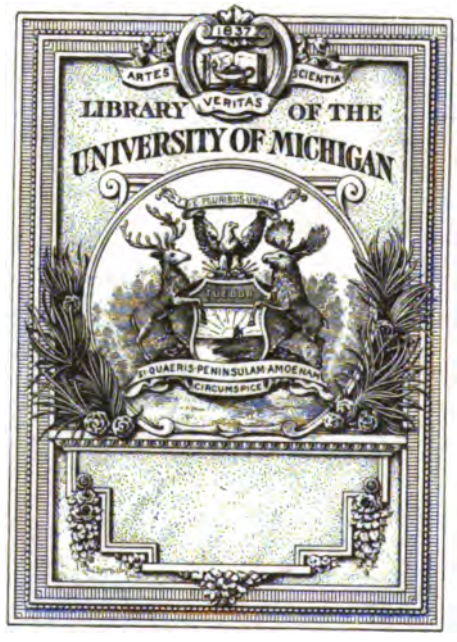
ANNUAL MEETING.

Held in Chipman Hall, 88 Tremont Street, Boston, Mass.

APRIL 26-27, 1905.

Office of the Association:
Room 57, International Trust Building, 45 Milk Street,
Corner of Devonshire St., Boston, Mass.

1905.



THE GIFT OF

Association.

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1550
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NEW ENGLAND

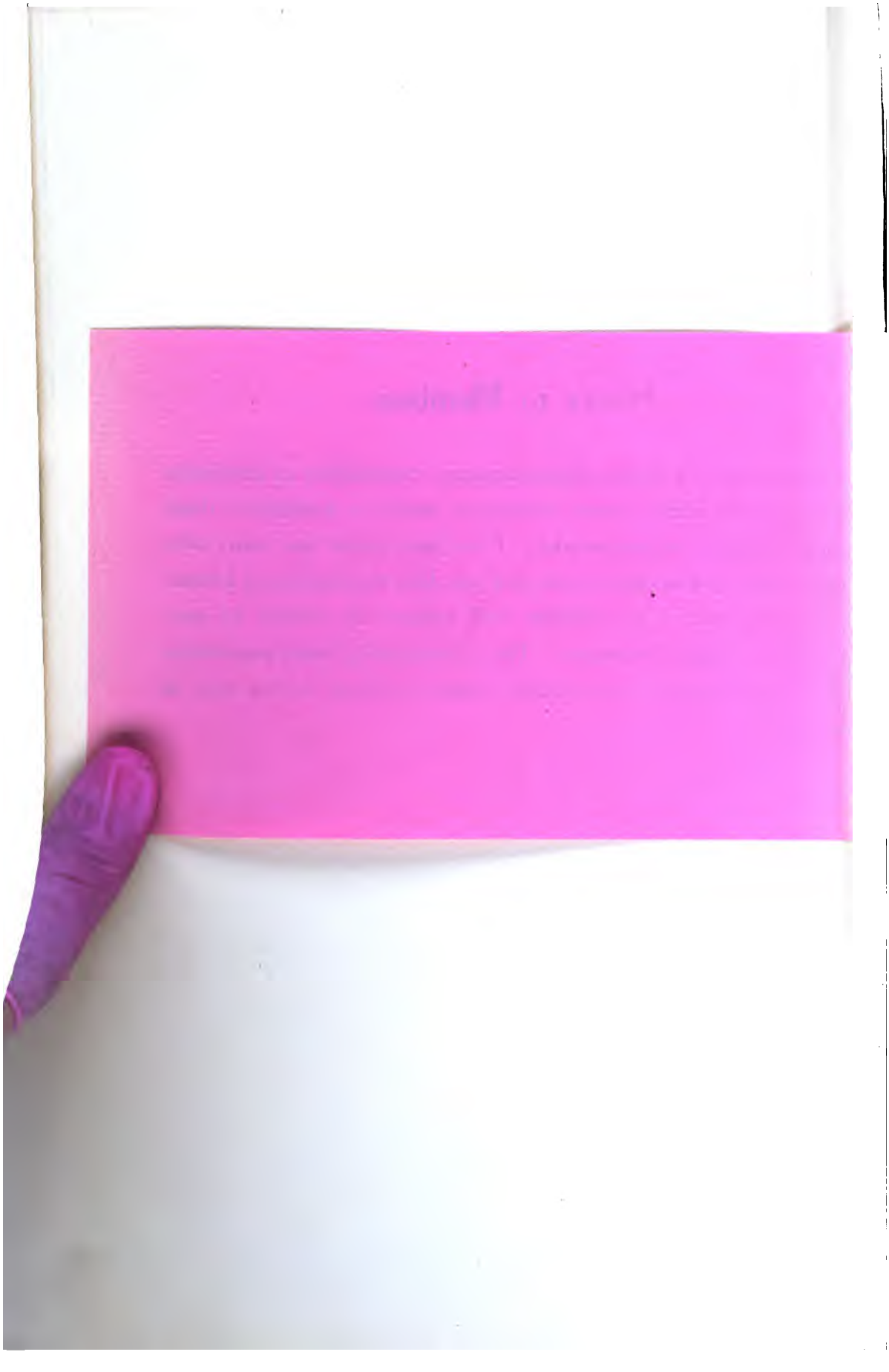
Cotton Manufacturers' Association.

Proposal for

Membership of

Notice to Members.

To make the Cotton Manufacturers' Association an absolutely representative body it must include as many as possible of those who are eligible for membership. It has been found that many who were eligible and desired to join had not done so because not invited. It is hoped that every member will present the matter to non-members among his associates. The accompanying blank proposition for membership can be detached from the cover at the row of perforations.



NEW ENGLAND

Cotton Manufacturers' Association.

Proposal for

....

Membership of

. . ..

Application Received

. . ..190 .

Action by Board of Government,.....favorable.

.....190 .

Voted by the Association,..... ...elected.

....190 .

New England
Cotton Manufacturers' Association,

Room 57, International Trust Building,

45 MILK STREET,

BOSTON, MASS.

PROPOSAL FOR MEMBERSHIP.

(When filled out, to be mailed to the Secretary, P. O. Box 3672, Boston, Mass., in time for action by the Board of Government, at least one week before a meeting of the Association.)

Mr. .....

Position, ...

P. O. Address, ...

is proposed for ..... *membership in the* NEW ENGLAND COTTON
active or associate

MANUFACTURERS' ASSOCIATION *by* .....
signature of member proposing candidate.

a member of the Association.

Experience of Applicant, (Please state, in full, particulars of detail, giving names, dates, and nature of work, as fully as convenient.)

.....

.....

.....

.....

.....

.....

.....

.....

The undersigned certifies that the above statements are correct, and agrees that, if elected to the Association, he will be governed by its rules as long as his connection with it shall continue.

Date, ... 190 .

.....
signature of candidate.

TRANSACTIONS

OF THE

New England

COTTON MANUFACTURERS' ASSOCIATION.

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Room 57, International Trust Building, 45 Milk Street,
Corner of Devonshire St., Boston, Mass.

1905.

ENTERED ACCORDING TO ACT OF CONGRESS
IN THE YEAR 1905
BY THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,
IN THE OFFICE OF THE LIBRARIAN OF CONGRESS
AT WASHINGTON.

By vote of the Board of Government, the price of the *Transactions* is $5.00 per copy to non-members. The price of this issue and the one previous is $1.00 each to members, and the prices of copies previous to Volume 61, is 50 cents to members but each member is entitled to a copy as a part of the privilege of membership.

CHARTER.

No. 6091.

Commonwealth of Massachusetts.

BE IT KNOWN, That whereas, EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN have associated themselves with the intention of forming a corporation under the name of the NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION, for the purpose of encouraging scientific investigation and experiment as to the methods of manufacturing cotton; collecting and imparting information relating to this industry, promoting social intercourse among its members; and establishing and maintaining a library of works on textiles in the city of Boston, and have complied with the provisions of the Statutes of this Commonwealth in such case made and provided, as appears from the certificate of the President, Treasurer and Directors of said corporation, duly approved by the Commissioner of Corporations, and recorded in this office.

Now, Therefore, I, WILLIAM M. OLIN, Secretary of the Common wealth of Massachusetts, do hereby certify that said EDWARD W. THOMAS, C. J. H. WOODBURY, WILLIAM J. KENT, F. M. MESSENGER, HARRY T. WHITIN, ARTHUR H. LOWE, ALBERT F. KNIGHT, ALFRED M. GOODALE, FRED C. MCDUFFIE and GEORGE W. BEAN, their associates and successors, are legally organized and established as and are hereby made an existing corporation under the name of the

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION,

with the powers, rights and privileges, and subject to the limitations, duties and restrictions which by law appertain thereto.

Seal of the Commonwealth of Massachusetts.

Witness my official signature hereunto subscribed, and the seal of the Commonwealth of Massachusetts hereunto affixed this first day of December, in the year of our Lord one thousand eight hundred and ninety-four.

WILLIAM M. OLIN,

Secretary of the Commonwealth.

157078

Commonwealth of Massachusetts.

(Acts of 1895, Chap. 163.)

AN ACT TO AUTHORIZE THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION TO HOLD ITS MEETINGS WITHOUT THE COMMONWEALTH.

Be it enacted, etc., as follows:

SECTION 1. The New England Cotton Manufacturers' Association is hereby authorized to hold its meetings in any state or territory of the United States and in the District of Columbia; provided, however, that its annual meeting shall be held in this Commonwealth at least once in five years.

SECT. 2. This act shall take effect upon its passage. [Approved March 23, 1895.]

AMENDMENT TO CONSTITUTION AND BY-LAWS.

The following amendment was adopted at the seventy-fifth meeting of the Association, September 30, 1903:

"ARTICLE 5. Any active or associate member by the single payment of one hundred dollars shall be exempt from all future payments for dues and shall become a life member having all the privileges of active members.

All moneys thus paid shall be invested as a permanent fund by the Treasurer acting under the direction of the Board of Government, of which the income only shall be subject to appropriation for current expenses.

All articles of the Constitution and By-Laws, beginning with Article 5, shall be increased in number to the next cardinal number."

NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

FOUNDED APRIL 20, 1865.

INCORPORATED DECEMBER 1, 1894.

CONSTITUTION AND BY-LAWS.

ACTIVE MEMBERS.

ARTICLE 1. Any person who is actively engaged as President, Treasurer, Agent, Superintendent or Manager in the manufacture, printing or finishing of cottons shall be eligible for active membership

ELECTION OF MEMBERS.

ARTICLE 2. All nominations for membership shall be made in writing, at least one week before the date of any regular meeting, and shall be considered by the Board of Government, and reported to the meeting, favorably or adversely, for the action of the Association. *Provided*, that in case the Board shall decide to report adversely upon any nomination, the member who shall have made it shall be informed of the intention so to report, in order that he may have an opportunity to withdraw the name. Upon such report active members may be admitted, if they obtain a majority of votes of the members present and voting therefor, by acceptance in writing, and paying an admission fee of ten dollars, and maintaining their membership by the payment of an annual assessment not exceeding ten dollars.* Any member failing to pay two successive assessments shall cease to be a member at the end of six months from the date when such second assessment shall become due. Any member may withdraw from the Association upon payment of all arrearages, first giving notice of his intention so

* This assessment has never exceeded five dollars for active members and ten dollars for associate members.

to do, in writing, to the Secretary, and the Board of Government may accept such resignation; and any member may be expelled for cause, at any regular meeting, two-thirds of the members present voting therefor.

ASSOCIATE MEMBERS.

ARTICLE 3. Persons engaged in the manufacture of cotton or cotton fabrics, or the manufacture of textile machinery, or industries kindred to the cotton manufacture, may become associate members of the Association. The methods of application, nomination, election and withdrawal from the Association being under the same conditions as those provided for active members in Article 2 excepting that this class of membership does not carry with it the privilege of voting or speaking, except by permission from the Board of Government or a vote of the Association to allow permission.

The initiation fee for associate members shall be twenty-five dollars, and the annual assessment shall be double the sum annually voted for active members.

Associate members may be expelled by a majority vote of the Board of Government.

HONORARY MEMBERS.

ARTICLE 4. Honorary members may be elected, when recommended by the Board of Government, at any regular meeting of the Association, who shall be enrolled as such, and shall be entitled to attend the meetings of the Association and participate in its proceedings, without the right to vote. They shall not be subject to payment of admission fees or assessments. No person actively engaged in cotton manufacture shall be eligible to honorary membership.

LIFE MEMBERS.

ARTICLE 5. Any active or associate member by the single payment of one hundred dollars shall be exempt from all future payments for dues and shall become a life member having all the privileges of active members.

All moneys thus paid shall be invested as a permanent fund by the Treasurer acting under the direction of the Board of Government, of which the income only shall be subject to appropriation for current expenses.

ARTICLE 6. It shall be the duty of all members of the Association to make returns to the Secretary of such statistics as may be called for by him, under the direction of any committee duly appointed for the collection of statistics, when not incompatible with private interests.

OFFICERS.

ARTICLE 7. The officers of this Association shall be a President, two Vice-Presidents, six Directors, a Treasurer, Secretary, and Auditor of Accounts.

ELECTION OF OFFICERS.

ARTICLE 8. At each annual meeting there shall be chosen by ballot a President, two Vice-Presidents and two Directors; the President and Vice-Presidents to serve one year, and the two Directors shall be chosen for terms of three years, unless sooner removed as hereinafter provided.

DUTIES OF OFFICERS.

ARTICLE 9. The President, or in his absence the senior Vice-President present, shall preside at all meetings of the Association and of the Board of Government. All officers shall hold their respective offices until their successors shall be chosen and accept their positions.

ARTICLE 10. The President, Vice-Presidents and Directors shall constitute a Board of Government, and have under their care and direction all matters pertaining to the management of the Association; and five of their number shall constitute a quorum for the transaction of business. Meetings of the board may be called by the President, at such time and place as he may deem expedient, giving each member a written or printed notice of the same at least five days before the day of meeting. At their first meeting the board shall elect a Treasurer, Secretary, and Auditor of Accounts for the year ensuing, and fix the amount of compensation of the Secretary. All vacancies in their board occasioned by death or resignation or removal, shall be filled by the board; and the persons so elected shall hold their offices until the next annual meeting except as hereinafter provided. The board may, from time to time, as they shall deem expedient, appoint committees, from among their own board or from the members at large, to collect statistical information, examine new inventions or processes

in manufacturing goods, as also to prepare essays on subjects of interest to the Association.

ARTICLE 11. The Treasurer shall keep a book in which all receipts and payments of money shall be entered, collect all moneys due the Association, and disburse the same upon the written order of the Board of Government. At the annual meeting in each year he shall make an exhibit of his accounts, or oftener if the Board of Government require it. He shall notify the members of assessments voted, and cause them to be collected in a reasonable time.

ARTICLE 12. The Secretary shall attend all meetings of the Association and of the Board of Government, and keep accurate records of their doings. In the absence of the Secretary at any meeting, a Secretary *pro tem.* may be appointed by the presiding officer, who shall be sworn to do all things, while in office, required of the Secretary.

ARTICLE 13. The Auditor shall examine the accounts of the Treasurer annually, and report at each meeting the state of the finances.

ARTICLE 14. Any officer who shall unreasonably absent himself from three consecutive meetings of the Board of Government of which he is a member, or shall otherwise neglect or refuse to perform the duties of his office, may be removed from office at any regular meeting of the Board of Government by a vote of a majority of the members present and voting thereon, a notice of such proposed action to be sent to him by mail at least one week previous to the meeting.

MEETINGS.

ARTICLE 15. The annual meeting of the members of the Association shall be held on the last Wednesday of April, or at such other time, and at such hour and place as the Board of Government may appoint. There shall also be a semi-annual meeting of the Association on the last Wednesday of October, in each and every year, or at such other time, and at such place and hour as the Board of Government may appoint.

Special meetings may be called by the Board of Government whenever they deem it expedient, or upon the written application of any ten members, made to the Secretary.

ARTICLE 16. All meetings of the members of the Association shall be in pursuance of a written or printed notice, addressed to each mem-

ber, with the name of the President or Secretary attached thereto, and deposited in the Post Office ten days at least before the day of meeting, specifying the time and place of meeting; and at all such meetings fifteen members shall constitute a quorum for the transaction of business.

ARTICLE 17. Amendments to the By-Laws may be made at any stated meeting of the Association by a two-thirds vote; *provided*, notice of such proposed amendment be given in writing at a previous meeting, and also notice be given to each member by the Secretary, of the pendency of such amendment, ten days at least before any such meeting.

BOARD OF GOVERNMENT.

1905.

PRESIDENT.

JAMES R. MacCOLL, ... PROVIDENCE, R. I.

VICE-PRESIDENTS.

WILLIAM D. HARTSHORNE, . . LAWRENCE, MASS.
GEORGE A. AYER, ... EASTHAMPTON, MASS.

DIRECTORS.

CHRISTOPHER P. BROOKS, . . . NEW BEDFORD, MASS.
GEORGE P. GRANT, JR., . . . FITCHBURG, MASS.
WILLIAM H. LOFTUS . . . . NEWARK, N. J.
PHILIP A. MATHEWSON, . . . FALL RIVER, MASS.
ROSCOE S. MILLIKEN, . . . NASHUA, N. H.
CHARLES T. PLUNKETT, . . . ADAMS, MASS.

AUDITOR.

C. E. ROBERTS, ... BOSTON, MASS.

SECRETARY AND TREASURER.

C. J. H. WOODBURY, P. O. Box 3672, BOSTON, MASS.

OFFICE OF THE ASSOCIATION:

ROOM 57, INTERNATIONAL TRUST BUILDING, 45 MILK STREET, CORNER OF DEVONSHIRE STREET, BOSTON, MASS.

OFFICERS OF THE ASSOCIATION,

FROM THE FIRST ORGANIZATION.

PRESIDENTS.

Ezekiel A. Straw,	1865–78	A. M. Goodale,	1895–96
Amos D. Lockwood,	1878–80	Arthur H. Lowe,	1896–97
John Kilburn,	1880–83	Russell W. Eaton,	1897–98
William C. Lovering,	1883–85	Stephen A. Knight,	1898–99
Richard Garsed,	1885–86	Frederick E. Clarke,	1899–99
J. S. Ludlam,	1886–88	D. M. Thompson,	1900–01
Henry F. Lippitt,	1888–89	Charles H. Fish,	1901–03
Walter E. Parker,	1889–92	H. E. Walmsley,	1903–05
Robert McArthur,	1892–94	James R. MacColl	1905–
Edw. W. Thomas,	1894–95		

VICE-PRESIDENTS.

Amos D. Lockwood,	1865–77	Simeon B. Chase,	1891–93
William A. Burke,	1865–73	E. W. Thomas,	1892–94
John C. Palfrey,	1873–76	A. M. Goodale,	1893-95
Edward Atkinson,	1876–78	William J. Kent,	1894–97
A. G. Cumnock,	1877–80	Fred. C. McDuffie,	1895–00
Charles Nourse,	1878–81	Henry T. Whitin,	1897–00
William F. Goulding,	1880–83	C. H. Richardson,	1900–01
Richard Garsed,	1881–85	George H. Hills,	1900–02
J. S. Ludlam,	1883–86	H. E. Walmsley,	1901–03
Walter E. Parker,	1885–89	Alfred E. Adams,	1902–03
Richard B. Borden,	1886–88	James R. MacColl,	1903–05
Arnold B. Sanford,	1888–91	W. D. Hartshorne,	1903–
Robert McArthur,	1889–92	George A. Ayer,	1905–

DIRECTORS.

J. S. Davis,	1865–69	E. W. Thomas,	1888–92
Charles Nourse,	1865–78	William W. Whitin,	1888–93
Phineas Adams,	1865–74	Robert R. Smith,	1889–92
William P. Haines,	1865–69	Alfred M. Goodale,	1890–93
Thomas J. Borden,	1865–78	William J. Kent,	1891–94
Daniel D. Crombie,	1865–68	Herman F. Straw,	1891–93
A. M. Wade,	1868–69	Fred C. McDuffie,	1892–95
D. J. Johnston,	1869–70	George W. Bean,	1892–95
F. E. Clarke,	1869–75	F. M. Messenger,	1893–95
A. G. Cumnock,	1869–77	Albert F. Knight,	1893–99
Cyrus I. Barker,	1875–80	Arthur H. Lowe,	1894–96
Hervey Kent,	1877–81	Henry T. Whitin,	1894–97
David J. Johnston,	1878–82	Herbert L. Pratt,	1895–98
Walter Paine, 3d,	1878–80	Stephen A. Knight,	1895–98
Chas. L. Lovering,	1878–83	John Eccles,	1895–99
Richard Garsed,	1880–81	Russell W. Eaton,	1896–97
William H. Jennings,	1880–83	C. H. Richardson,	1897–00
Chas. D. McDuffie,	1881–83	George H. Hills,	1897–00
Walter E. Parker,	1881–85	John T. Meats,	1898–01
John W. Danielson,	1881–85	Alfred E. Adams,	1899–02
William E. Barrows,	1882–83	A. Tenny White,	1899–02
Rufus A. Maxfield,	1883–86	Charles H. Fish,	1900–01
George W. Weeks,	1883–86	Herbert E. Walmsley,	1900–01
Henry S. Howe,	1883–87	Wm. D. Hartshorne,	1901–03
Richard B. Borden,	1883–86	James R. MacColl,	1901–03
O. S. Brown,	1885–91	Geo. F. Whitten,	1898–04
Henry F. Lippitt,	1885–88	W. B. Smith Whaley,	1901–04
Wilbur A. Stiles,	1886–88	J. R. Montgomery,	1902–05
Robert McArthur,	1886–89	Wm. D. Pennell,	1902–05
Stephen N. Bourne,	1886–91	George A. Ayer,	1904–05
John Kilburn,	1870–80	G. P. Grant, Jr.,	1903–
William P. Haines,	1874–78	P. A. Mathewson,	1903–
S. S. Spencer,	1887–90	Christopher P. Brooks,	1904–

DIRECTORS.— Continued.

William H. Loftus,	1905	Roscoe S. Milliken,	1905
Charles T. Plunkett,	1905		

AUDITORS.

Benjamin Saunders,	1865–71	J. Herbert Sawyer,	1882–00
John C. Palfrey,	1871–73	C. E. Roberts,	1900–
Henry D. Sullivan,	1873–82		

SECRETARY AND TREASURER.

Ambrose Eastman,	1865–94	C. J. H. Woodbury,	1894

MEMBERS OF THE ASSOCIATION.

May 1, 1905.

Members of the Association are respectfully requested to scrutinize the following list, and advise the Secretary, P. O. Box 3672, Boston, Mass., of change in address, or any error in regard to their names.

As a number of members rejoined the Association after severing their first membership, the date of their earliest election is given.

HONORARY MEMBERS.

George Arms	Grand Hotel	New York City	Oct. 16, 1872.
Henry Smith Pritchett, LL.D.,	Pres. Mass. Institute of Technology,	Boston, Mass.	Sept. 26, 1901.
Samuel Webber	Hydraulic Engineer	Charlestown, N. H.	Apr. 20, 1865.

LIFE MEMBERS.

Charles H. Fish,	Agt. Cocheco Manufg. Co.,	Dover, N. H.,	Apr. 27, 1887.
John R. Mitchell	Mitchell-Bissell Co.	38 Murray St., New York City	Oct. 18, 1900.
Robert W. Neff	Chemical Mfr.,	22 India Sq., Boston, Mass.,	Apr. 24, 1902.
Walter E. Parker	Agt. Pacific Mills	217 Haverhill St., Lawrence, Mass.	Apr. 25, 1877.
George I. Rockwood	Mech. Eng.	62 Summer St., Worcester, Mass.	Apr. 25, 1901.
Robert Schaellibaum	Pres. Rob. Schaellibaum Co.	Providence, R. I.	Sept. 22, 1904.
C. J. H. Woodbury,	Secretary and Treasurer,	51 Baltimore St., Lynn, Mass.,	Oct. 29, 1879.

ACTIVE MEMBERS.

Alfred E. Adams	Agt. Whitinsville Cotton Mills / Agt. Linwood Mills	Whitinsville, Mass.	Apr. 27, 1887.
Ivers S. Adams	Supt. American Net and Twine Co.	East Cambridge, Mass.	Sept. 22, 1904.
John S. Adams, Jr.	Supt. Adams Bros. Mfg. Co.	120 Commercial St., Adams, Mass.	Apr. 29, 1896.

Robert Franklin Adams, Treas. The Adams Mfg. Co. . . . . 106 Grand St., New York, N. Y. . . Sept. 22, 1904.
William P. Adams . . Supt. Pittsfield Mills, ... Pittsfield, N. H., . . Apr. 28, 1904.
James W. Ahmuty . . Supt. Atlantic Cotton Mills, ... Lawrence, Mass., . . Apr. 28, 1904.
Joseph D. Aiken . . . Asst. Supt. Ponemah Mills . . . . Taftville, Conn. . . . Oct. 28, 1891.
F. S. Akin . . . . . Supt. Cornell Mills . . . . . Fall River, Mass. . . Sept. 27, 1894.
Charles T. Aldrich . . Treas. Aldrich Mfg. Co. . . . . 37 Weybosset St., Box 34, Providence, R. I. . . Apr. 28, 1886.
John W. Allis . . . Vice-Pres. and Agt. Utica Knitting Co., ... Utica, N. Y. . . . . Apr. 27, 1905.
George E. Ames . . . Mech. Supt. Lawrence Mfg. Co. . . Lowell, Mass. . . . Apr. 24, 1895.
William Ames . . . . Treas. Fletcher Manufg. Co., Box 83, ... 47 Charles St., Providence, R. I. . Apr. 30, 1879.
Charles B. Amory . . . Treas. Hamilton Manufg. Co. . . . . 70 Kilby St., Boston, Mass. . . . Apr. 25, 1894.
Frederic Amory . . . Treas. Nashua Mfg. Co. and Jackson Mfg. Co. . . . . Room 51, Simmons B'l'd., 40 Water St., Boston, Mass. . . . Apr. 27, 1899.
Thomas Armstrong . . Supt. No. Pownal Mfg. Co. . . . . No. Pownal, Vt. . . Oct. 28, 1897.
Abel T. Atherton . . . Machine Maker . . . . . Longmeadow, R. I. . Oct. 16, 1872.
William F. Arthur . . Supt. Nashua Mfg. Co. . . . . Nashua, N. H. . . . Apr. 23, 1903.
Edward Atkinson . . . Prest. Boston Mfrs. Mu. Fire Ins. Co. . . . . 31 Milk St., Boston, Mass. . . . Apr. 19, 1871.
E. W. Atkinson . . . . Stoddard, Haserick, Richards & Co. . . . . 152 Congress St., Boston, Mass. . . . Oct. 27, 1886.
H. C. Atwood . . . . Treas. Williamsville Manufg. Co. . . Killingly, Conn. . . Apr. 29, 1885.
James A. Atwood . . . Agt. Wauregan Co. and Quinebaug Co. . . . . Wauregan, Conn. . . Oct. 28, 1891.
John Walter Atwood . Supt. Wauregan Co. . . . . Wauregan, Conn. . . Oct. 25, 1895.
W. E. Atwood . . . . Pres. Williamsville Manufg. Co. . . Killingly, Conn. . . . Sept. 27, 1894.
George A. Ayer . . . Supt. West Boylston Co. . . . . Easthampton, Mass. . Apr. 24, 1895.
Nathaniel F. Ayer . . . . . 10 P. O. Square, Boston, Mass. . . . . Apr. 25, 1901.

J. W. Bailey . . . . . Principal, The Bradford Durfee Textile School . . . . Fall River, Mass. . . Apr. 23, 1903.
Dickerson G. Baker . . Mech. Eng., American Thread Co. . . . . P. O. Box B, Willimantic, Conn. . Oct. 18, 1900.
Edwin H. Baker . . . Bliss, Fabyan & Co., Box 2899 . . . . . 117 Duane St., New York, N. Y. Apr. 24, 1878.
Edward R. Ballou . . . Treas. Ballou Yarn Co., ... 189 Charles St., Providence, R. I. . . Apr. 25, 1894.
Frederick D. Ballou . . Supt. W. A. Slater Mills . . . . . Jewett City, Conn. . Apr. 23, 1903.
William P. Bancroft . . Vice-Pres. Joseph Bancroft & Sons Co. . . . . Wilmington, Del. . . Oct. 31, 1883.
Louis B. Barker . . . Agt. United States Cotton Co. . . . Central Falls, R. I. . Apr. 27, 1899.
V. T. Barber . . . . . Supt. Slater Cotton Co. . . . . Pawtucket, R. I. . . Oct. 2, 1902.
J. E. Barbour . . . . Pres. Barbour Flax Spinning Co., . Paterson, N. J. . . . Apr. 28, 1904.

Lewis E. Barnes	Agt. Pemberton Co. & Methuen Co.,	Methuen, Mass.	Oct. 25, 1895.
William A. Barrell	Agt. Lawrence Duck Co.	Lawrence, Mass.	Apr. 30, 1884.
Thomas Barrett, Jr.	Pres. Langley & Aiken Mills	Augusta, Ga.	Apr. 26, 1900.
Edward E. Bartlett	Supt. Sibley Mfg. Co.,	Augusta, Ga.	Sept. 22, 1904.
Edwin N. Bartlett	Supt. Sigourney and Rockdale Mills,	North Oxford, Mass.	Apr. 29, 1891.
Daniel Moore Bates	Asst. Supt. Joseph Bancroft & Sons Co.,	Rockford, Wilmington, Del.	Apr. 27, 1898.
Joseph P. Battles	Sec'y Joseph Battles Co.,	Lawrence, Mass.,	Oct. 25, 1895.
Edward C. Beach	Gen. Mgr. Gate City Cotton Mills	East Point, Georgia	Oct. 5, 1899.
C. Enos Bean	Agt. Lawrenceville Mfg. Co.	Lawrenceville, Ga.	Apr. 24, 1902.
George W. Bean	Agt. Androscoggin Mills	Lewiston, Me.	Apr. 17, 1872.
Robert Beatty	Robert Beatty & Co.	Coral and Adams Sts., Philadelphia, Pa.	Oct. 28, 1897.
John W. Bell	Asst. Treas. and Gen. Mgr. Smith & Dove Manufg. Co.	Andover Mass.	Oct. 28, 1897.
Albert Farwell Bemis	Pres. Jackson Fibre Co., (Jackson, Tenn.)	P. O. Box 5173, 89 State St., Boston, Mass.	Apr. 23. 1903.
A. C. Bent	Agt. Safety Seamless Pocket Co.	Taunton, Mass.	Oct. 28, 1897.
William H. Bilbrough	Mgr. and Treas. Elmira Knitting Mills and Mgr. Conewawah Spinning Co.,	Elmira, N. Y.	Apr. 24, 1902.
W. N. Blackstone	Treas. Attawaugan Co. Treas Totokett Mills Co	Norwich, Conn.	Apr. 29, 1896.
Wm. Washington Blades,	Gen. Supt. Lorraine Mfg. Co.	135 Mineral Spring Ave., Pawtucket, R. I.	Oct. 25, 1893.
T. Ashby Blythe	Proprietor Ashby Cotton Mills	114 Chestnut St., Philadelphia, Pa.	Oct. 28, 1897.
John P. Bodge	Treas. Arkwright Mills	Fall River, Mass.	Oct. 28, 1897.
Jefferson Borden, Jr.	Supt. Fall River Bleachery Co.	Fall River, Mass.	Apr. 21, 1899.
Nathaniel B. Borden	Treas. Barnard Manufg. Co.	Fall River, Mass.	Oct. 15, 1873.
Raymond D. Borden	Treas. Watuppa Mills,	Taunton, Mass.	Sept. 22, 1904.
Richard B. Borden	Treas. Richard Borden Mfg. Co. Treas. Troy C. & W. Mfg. Co.	Fall River, Mass.	July 19, 1865.
E. S. Boss	Agt. American Thread Co.	Willimantic, Conn.	Oct. 29, 1879.
A. E. Bosworth	Supt. Bernon Mills	Georgiaville, R. I.	Oct. 2, 1902.
Henry Deane Bourne	Treas. Hooksett Mfg. Co.,	1741 Elm St. Manchester, N. H.	Oct. 18, 1900.
Stephen N. Bourne	Agt. Dundee Mills	971 Chestnut St., Manchester, N. H.	Oct. 21, 1868.
Frank A. Bowen	Supt. Appleton Co.	Lowell, Mass.	Apr. 28, 1897.
Arthur F. Brackett	Supt. Royal Arctic & Valley Queen Mills,	Riverpoint, R. I.	Oct. 25, 1895.
Albert W. Brainerd		Box 33, Lawrence, Mass.	Apr. 27, 1898.
S. Parker Bremer	Treas. Monadnock Mills	4 Winthrop Sq., Boston, Mass.,	Oct. 2, 1902.
Ernest Bridge	Supt. Jas. Chadwick & Bro. Ltd.	Jersey City, N. J.	Apr. 24, 1895.
George T. Briggs	Pres. and Gen. Mgr. The Briggs Mfg. Co.	Voluntown, Conn.,	Apr. 24, 1902.
Jas. T. Broadbent	Instr. Carding and Spinning, Bradford Durfee Textile School,	Fall River, Mass.,	April 28, 1904.

Christopher P. Brooks . Prin. Textile Dept., International Correspondence School, ... New Bedford, Mass. Apr. 28, 1897.
Henry R. Brown . . . Supt. Phenix Mill . . . . . Box 56, Phenix, R. I. . . . . Apr. 28, 1897.
Isaac A. Brown . . . . Treas. Narragansett Mills . Box 324, Fall River, Mass. . . Sept. 29, 1898.
Thomas J. Brown . . . George Brown's Sons . . . . . Mt. Joy, Penn. . . . Oct. 28, 1897.
E. C. Bucklin . . . . Treas. Interlaken Mills . . . . . Butler's Exchange, Box 289, Providence, R. I. . . . Apr. 25, 1883.
Harris H. Bucklin . . Asst. Treas. Interlaken Mills . . . Providence, R. I. . . . Apr. 23, 1903.
E. R. Bullock, ... Mech. Eng., J. & P. Coats, Ltd., . . Pawtucket, R. I. . . . Apr. 28, 1904.
Robert Burgess . . . . Treas. Slater Cotton Co. . . . . 128 Walcott St., Pawtucket, R. I. . . . Apr. 27, 1892.
Edward N. Burke . . . Lowell Machine Shop . . . . . 216 Nesmith St., Lowell, Mass. . . . Apr. 28, 1880.
Alfred H. Burnham . . Mgr. Glasgow Mills, Station Kensington . . . . . Huntington and Jasper Sts., Philadelphia, Pa. . . Apr. 26, 1900.
Hervey Burnham . . . Supt. Beaver Mills and Eclipse Mill . . . . . 234 East Main St., North Adams, Mass. . Apr. 27, 1899.
W. R. Burnham . . . . . Norwich, Conn. . . . Apr. 29, 1885.
John L. Burton . . . . . 1042 Plymouth avenue, Fall River, Mass. . . Apr. 23, 1903.

William H. Cadwell . . Agt. Jackson Company . . . . . Nashua, N. H. . . . Apr. 26, 1900.
John P. Campbell . . . Supt. New York Mills, New York Mills, Oneida Co., N. Y., Sept. 22, 1896.
Byron F. Card . . . . Mgr. . . . . Charlotte Machine Co., Charlotte, N. C. . . . Apr. 25, 1888.
Alfred M. Chadwick, . Asst. Agt. Tremont & Suffolk Mills, Lowell, Mass. . . . Apr. 28, 1904.
John W. Chafee . . . Pres. and Treas. The Sibley Mfg. Co. Augusta, Ga. . . . . Oct. 18, 1900.
Simeon B. Chase . . . Treas. King Philip Mills . . . . . Fall River, Mass. . . Apr. 21, 1875.
Chas. E. Childs . . . . Treas. Hampton Co., Asst. Treas. West Boylston Co. . . . . Northampton, Mass. . Oct. 1, 1903.
Clarence N. Childs . . Asst. Supt. Hamilton Manufg. Co. . . . . 43 Pine St., Lowell, Mass. . . . Apr. 24, 1895.
Elmer G. Childs . . . Agt. Boston Duck Co. . . . . Bondsville, Mass. . . Oct. 26, 1892.
Jno. H. C. Church . . . Treas. and Gen. Mgr. Monument Mills, Housatonic, Mass. . Apr. 28, 1897.
Avery B. Clark, ... Supt. Merrimack Mfg. Co. . . . . Lowell, Mass. . . . . Apr. 27, 1905.
Daniel Clark . . . . . 16 Fifth ave., Lowell, Mass., . . . Apr. 23, 1903.
Ernest E. Clark . . . Mech. Supt. Montreal Cotton Co. . . Valleyfield, P. Q. . . Apr. 29, 1896.
E. N. Clemence . . . Cotton Manufacturer . . . . . Charlotte, N. C. . . . Apr. 28, 1897.
W. H. Cloher, Jr. . . . Treas. and Agt. Utica Cotton Co. Capron, Oneida Co., N. Y., Sept. 22, 1896.
Josiah G. Coburn . . . . . 99 Washington St., Newton, Mass. . . . Apr. 20, 1865.
Charles H. Collins . . Supt. Berkeley Co. . . . . Ashton, R. I. . . . . Apr. 26, 1900.
John A. Collins . . . . Supt. American Linen Co. . . . . 73 Cottage St., Fall River, Mass. . . Oct. 31, 1883.
Frank B. Comins . . . Treas. American Moistening Co. . . . . 150 Devonshire St., Room 67, Boston, Mass. . . . . Oct. 28, 1891.
Caesar Cone . . . . . Pres. Proximity Mfg. Co. . . . . Greensboro, N. C. . . Apr. 26, 1900.
John J. Connell . . . . Agt. Tremont & Suffolk Mills . . . Lowell, Mass. . . . Apr. 27, 1892.
Halsey Connett . . . . Supt. Clark Mile End Spool Cotton Co. East Newark, N. J. . Oct. 2, 1902.

Peter H. Corr . . . . Treas. Greenwich Bleachery . . . . Taunton, Mass. . . . Apr. 24, 1895.
Frank H. Cotton . . . . . Fayetteville, N. C . . Apr. 27, 1899.
Lyman M. Cousens, . . Pres. Dana Warp Mills . . . . . Portland, Me. . . . Apr. 24, 1902.
Alphonse S. Covel . . Treas. Tremont and Suffolk Mills, ... P. O. Box 1716, 70 Kilby St., Boston, Mass. . . . Oct. 31, 1877.
Richard Cowell . . . . . 77 Mt. Pleasant St., New Bedford, Mass. . Apr. 24, 1902.
William W. Crapo . . Pres. Wamsutta Mills . . . . . New Bedford, Mass. . Sept. 29, 1898.
Mark B. Creed . . . . Supt. 1, 2, 3 Wamsutta Mills . . . New Bedford, Mass. . Oct. 1, 1903.
George Crompton, . . Treas. Wachusett Mills and member firm Crompton-Thayer Loom Co., Worcester, Mass. . . Oct. 28, 1897.
John B. Cudlip . . . . Mgr. Cornwall & York Cotton Mills Co. . . . . St. John, N. B. . . . Apr. 28, 1897.
H. H. Culver . . . . . Supt. Elizabeth Poole Mills . . . . . 8 Coram St., Taunton, Mass. . . . Apr. 28, 1897.
Henry S. Culver . . . Treas. Westville Cotton Mills . . . Taunton, Mass. . . . Apr. 28, 1897.
A. G. Cumnock . . . . Treas. Appleton Co. . . . Box 2284, Lowell, Mass. . . . July 19, 1865.
Andrew J. Currier . . Kilburn Mills . . . . . New Bedford, Mass. . Apr. 25, 1888.

Philip Dana . . . . . Supt. Dana Warp Mills . . . . . Westbrook, Me. . . Sept. 29, 1898.
Woodbury K. Dana . . Treas. Dana Warp Mills . . . . . Westbrook, Me. . . . Apr. 25, 1888.
Albert W. Danforth . . Mech. Eng. Shanghai Cot. Cloth Mills, Shanghai, China . . 881 Bridge St., Lowell, Mass. . . . Apr. 27, 1881.
A. Lockwood Danielson Asst. Treas. Quinebaug Co., Box 900, Providence, R. I. . . Sept. 27, 1894.
J. DeForest Danielson { Asst. Treas. Lockwood Co. & Lewiston Bleachery & Dye Works } Providence, R. I. . . Sept. 27, 1894.
John W. Danielson . . Treas. Lockwood Co., Ponemah Mills, Quinebaug Co., Wauregan Co., Lewiston B. & D. Works, Box 900, Providence, R. I. . . July 15, 1868.
E. W. Davenport . . Supt. Brighton Mills . . . . . Passaic, N. J. . . . . Apr. 23, 1903.
Bradford D. Davol . . Pres. Barnard Mfg. Co., P. O. Box 93, Fall River, Mass. . . Apr. 25, 1877.
Albert Deabill . . . . Supt. Davis Hosiery Mills . . . . . Sherman Heights, Tenn. . . Apr. 25, 1901.
Augustus De Cort . . . Treas. Beacon Mfg. Co. . . . . P. O. Box 2815, 65 Franklin St., Boston, Mass. . . . . Apr. 26, 1900.
George DeForest . . . Treas. Utica Steam & Mohawk Valley Cotton Mills . . . . . Utica, New York . . Oct. 28, 1897.
William P. Dempsey . Treas. and Mgr. Dempsey Bleachery and Dye Works . . . . . Pawtucket, R. I. . . Apr. 28, 1886.
Charles W. Dennett . . Vice Pres. and Gen. Mgr. Hadley Mills, ... So. Hadley Falls, Mass. . . . Oct. 29, 1890.
Harlan Ingalls Dennett, Supt. Hadley Mills . . . . . South Hadley Falls, Mass. Apr. 27, 1905.
Edward P. Dennis . . . . . Lowell, Mass. . . . Apr. 25, 1888.
Charles A. Denny . . . . . Leicester, Mass. . . Apr. 25, 1888.
P. Y. DeNormandie . . Treas. Pepperell Mfg. Co. . . . . 30 Kilby St., Boston, Mass. . . . Apr. 29, 1896.
Charles Owen Dexter . Mgr. Canadian Colored Cotton Mills Co. Ltd. . . . . Hamilton, Ont., Can. Apr. 24, 1895.

George O. Dexter . . . Supt. Canadian Colored Cotton Mills Co. Hamilton, Ont. . . Apr. 27, 1905.
Henry C. Dexter, . . . Agt. and Sec. Greene & Daniels Mfg. Co. . . . . Pawtucket, R. I. . . Apr. 25, 1901.
Lewis Dexter, Jr. . . . Treas. & Mgr. Maginnis Cotton Mills Co., ... New Orleans, La. . . Apr. 27, 1899.
Albert W. Dimick . . . Agt. Fisher Mfg. Co. . . . . Fisherville, Mass. . . Apr. 25, 1894.
Bradford C. Divine . . Supt. Utica Willowvale Bleaching Co. Chadwicks, N. Y. . . Apr. 27, 1899.
Robert Dow, ... Partner in Solway Mills, ... Westerly, R. I. . . . April 25, 1901.
Arthur J. Draper . . . Treas. Pell City Mfg. Co. . . . . Pell City, Ala. . . . Apr. 23, 1903.
Eben S. Draper . . . Agt. Draper Co. . . . . Hopedale, Mass. . . Oct. 31, 1888.
George A. Draper . . . Treas. Draper Co. . . . . Hopedale, Mass. . . Oct. 31, 1888.
George Otis Draper . . Sec'y Draper Co. . . . . Hopedale, Mass. . . Apr. 24, 1895.
William F. Draper . . Pres. Draper Co. . . . . Hopedale, Mass. . . July 17, 1867.
Henry C. Dresser . . . Gen. Supt. Bibb Mfg. Co. . . . . Macon, Ga. . . . . Apr. 27, 1905.
Harry K. Drew . . . Supt. Fulton Bag and Cotton Mills . Atlanta, Ga. . . . . Apr. 24, 1902.
O. D. Drew . . . . . Supt. Dwight Manufacturing Co. . . Chicopee, Mass. . . Oct. 2, 1902.
James B. Duggan . . . Pres. Union Bleaching and Finishing Co. . . . . Greenville, S. C. . . Oct. 2, 1902.
Frederic C. Dumaine, . Treas. Amory Mfg. Co., Box 2879 . . . . . 64 Ames Building, Boston, Mass. . . . April 25, 1901.
Joseph M. Dunham . . . . . 43 Edwards St., Springfield, Mass. . . Oct. 26, 1892.
John H. Dunn . . . . Gen. Supt. Tremont & Suffolk Mills Lowell, Mass. . . . Oct. 1, 1903.
Frank J. Dutcher . . . Asst. Agt. Draper Co. . . . . Hopedale, Mass. . . Apr. 24, 1902.
Frank H. Dwelly . . . Treas. Tecumseh Mills . . . . . Fall River, Mass. . . Apr. 27, 1899.
David H. Dyer . . . . D. H. Dyer & Son, Mill Engineers, P. O. Box 582, ... 6, 7 and 8 Pocassett Bank Building, Fall River, Mass. . . Oct. 18, 1871.

Benjamin M. Earle . . Prop. Merchants Dye Works . . . . East Dedham, Mass. Sept. 26, 1901.
Wm. Ambrose Eastman, Gen. Mgr. Hooper Knitting Co. . . Lowell, Mass. . . . Apr. 24, 1878.
Russell W. Eaton . . . Agt. Cabot Manufg. Co. . . . . Brunswick, Me. . . . Oct. 27, 1887.
John Eccles . . . . . Agt. Ponemah Mills . . . . . Taftville, Conn. . . . Apr. 27, 1892.
Oscar Elsas . . . . . Vice-Pres. Fulton Bag & Cotton Mills, ... P. O. Box 773, Atlanta, Ga. . . . . Apr. 28, 1897.
Frederick W. Ely . . . Agt. Columbian Manufg. Co. . . . Greenville, N. H. . . Apr. 25, 1888.
H. B. Estes . . . . . Agt. Continental Mills . . . . . Lewiston, Me. . . . Apr. 26, 1893.
John H. Estes . . . . Cotton Manufacturer . . . . . Fall River, Mass. . . Apr. 23, 1903.
James C. Eteson . . . Supt. Orswell Mills, ... Fitchburg, Mass. . . Sept. 22, 1904.
William Evans . . . . Supt. Bourne Mills . . . . . Fall River, Mass. . Apr. 29, 1896.
D. A. Everly . . . . . Pres. . . . . 96 Broad St., Pawtucket, R. I. . . Apr. 24, 1902.

Charles F. Farrar . . . . . 49 Coggeshall St., Fall River, Mass. . . Oct. 28, 1897.
George E. Farrell . . . Sec. Ontario Knitting Co. and Standard Yarn Mills, ... Oswego, N. Y. . . . Oct. 18, 1900.
James T. Ferguson . . Supt. Warwick Mills . . . . . Centreville, R. I. . . Oct. 5, 1899.
John A. Fernley . . . Asst. Supt. Butler Mill . . . . . New Bedford, Mass. . Sept. 22, 1904.
Frank S. Field . . . . Supt. & Agt. Massaemit Yarn Mills . Shattuckville, Mass. . Oct. 25, 1895.

Eugene Finocchiaro, . Asst. Supt. Cohannet Mills, ... 48 Adams St.,Taunton, Mass. . . . Apr. 28, 1904.

William Firth . . . . Pres. American Moistening Co. & Wm. Firth Co. . . . . P. O. Box 1460, 150 Devonshire St., Room 67, Boston, Mass. Apr. 25, 1888.

George Fish . . . . . Supt. Massachusetts Cotton Mills, . Lowell, Mass. . . . . Apr. 27, 1905.

Charles W. Fisher, . . Asst. Supt. Fisher Mfg. Co. . . . . Fisherville, Mass. . . Apr. 25, 1901.

Henry E. Fisher . . . Vice-Pres. & Agt. Atlanta Cotton Mills Atlanta, Ga. . . . . Oct. 25, 1895.

Frederick A. Flather . Treas. Boott Mills, ... Boston, Mass. . . . . Apr. 29, 1891.

F. C. Fletcher . . . . Vice Pres. Lawton Spinning Co. . . . . 621 Banigan Building, Providence, R. I. . . Oct. 18, 1900.

Henry J. Forsyth . . . Supt. Cooleemee Cotton Mill, . . . Cooleemee, N. C. . . Oct. 1, 1903.

M. F. Foster . . . . . Milford, N. H. . . . Apr. 17, 1872.

Edward W. France . . Dir. of Philadelphia Textile School, ... 320 So. Broad St., Philadelphia, Pa. . . Sept. 22, 1896.

Arthur C. Freeman . . Textile Finishing Machinery Co. . . . . 17 Exchange Place, Providence, R. I. . . Apr. 27, 1899.

Simon Friedberger . . Pres. Friedberger Mfg. Co. . . . . Germantown, Logan Station, Philadelphia, Pa. . . Apr. 23, 1903.

John W. Fries . . . { Managing Partner, F. & H. Fries & Pres. Arista Mills Co. . . . } Winston-Salem,N.C., . Oct. 18, 1900.

C. H. Frisbie . . . . Agt. Attawaugan Co. . . . . Norwich, Conn. . . . Oct. 29, 1890.

Hachiro Henry Fukuhara, Supt. Sumoto Mill, Kanegafuchi Spinning Co. . . . . Hiogo, Japan, . . . Apr. 28, 1904.

S. L. Gabriel . . . . . Treas. United States Linen Co. . . Taunton, Mass. . . . Sept. 22, 1904.

W. T. Galey . . . . . Pres. Aberfoyle Manufg. Co. . . . Chester, Pa. . . . . Apr. 28, 1897.

William Gammell . . . Agt. Berkeley Co. . . . . Providence, R. I. . . Oct. 28, 1885.

James G. Garland . . . . . Saco, Me. . . . . Oct. 29, 1879.

William H. Garner . . Agt. Newmarket Mfg. Co. . . . . Newmarket, N. H. . Sept. 22, 1904.

Edward T. Garsed . . . . . Charlotte, N. C. . . Apr. 27, 1898.

Walter R. Garsed . . . Mgr. Wingohocking Cotton Mills . . . . . Frankford, Philadelphia, Pa. . . Oct. 1, 1903.

E. Stanley Gary . . . Vice Pres. and Gen. Mgr. Gary Mfg. Co. . . . . 724 Equitable Bldg. Baltimore, Md. . . . Oct. 1, 1903.

James A. Gary . . . . Pres. Gary Mfg. Co. 306 Fidelity Bldg. Baltimore, Md. . . Apr. 25, 1883.

James Gee . . . . . Supt. Interlaken Dye Works . . . . Fiskville, R. I. . . . Apr. 27, 1898.

Charles E. Getchell . . Pres. Waltham Emery Wheel Co. . . . . Bacon St., Waltham, Mass. . . . Oct. 30, 1889.

R. H. I. Goddard Jr., . Goddard Bros. . . . . Providence, R. I. . . Apr. 27, 1905.

William C. Godfrey . . Agt. Indian Orchard Co. . . . . Indian Orchard, Mass. Oct. 29, 1890.

Otto Goetze, ... Partner and Treas. Glasgow Mills, . Huntington and Jasper Sts., Kensington Sta., Philadelphia, Pa. . . Apr. 24, 1902.

Alfred M. Goodale . . Treas. Boston Manufg. Co. . . . . 50 State St., Boston, Mass. . . . . Apr. 25, 1883.

Frederick B. Gordon . Pres. Columbus Mfg Co. . . . . Columbus, Ga. . . . Apr. 26, 1900.

Charles H. Gorton . . Supt. Columbus Mfg. Co. . . . . Columbus, Ga. . . . Apr. 25, 1894.

Marcellus Gould . . . Pres. and Mgr. N. H. Spinning Mills, Penacook, N. H. . . Sept. 22, 1896.
George P. Grant, Jr. . . Treas. Grant Yarn Co. . . . . Fitchburg, Mass. . . Sept. 27, 1894.
D. W. Gray . . . . . Supt. Skenandoa Cotton Co. . . . . Utica, N. Y. . . . . Oct. 26, 1892.
R. A. Gray . . . . . Supt. Rodman Manufg. Co. . . . . Allenton, R. I. . . . Apr. 24, 1895.
Edwin Farnham Greene, Asst. Treas. Dwight Mfg. Co. & Pres. Lockwood, Greene & Co.
. . . . . Boston, Mass. . . . Apr. 24, 1902.
Frederick Stuart Greene Mgr. Transmission Rope Dept., The American Mfg. Co. .
. . . . . 65 Wall St., New York City . . . Oct. 1, 1903.
Joseph Warren Greene . Hamilton Web Co. . . . . Hamilton, R. I. . . . Apr. 29, 1896.
William C. Greene . . Treas. Peace Dale Manufg. Co. . . Peace Dale, R. I. . . Oct. 27, 1886.
John T. Greenwood . . R. Greenwood & Bault . . . . . .
. . . . . 4720 Leiper St., Frankford, Philadelphia, Pa. . . Apr. 26, 1900.
S. Greenwood . . . . Mgr. Canadian Col'd Cot. Mills Co. Ltd. . . . . .
. . . . . Cornwall, Ontario . . Oct. 5, 1899.
John Gregson . . . . Agt. Fiskdale Mills . . . . . Fiskdale, Mass. . . . Apr. 24, 1895.
Maxwell Grierson . . . Gen. Mgr. Jas. Chadwick & Bro., Ltd., Jersey City, N. J. . . Apr. 27, 1898.
Frederick Grinnell . . Pres. Gen. Fire Extinguisher Co. . . New Bedford, Mass. . Apr. 24, 1878.
David Grove . . . . . Supt. U. S. Cotton Co. . . . . Central Falls, R. I. . Apr. 27, 1898.
Henry S. Grove . . . Pres. Argo Mills Co., ...
. . . . . 318 Marine and Merchant Bldg., Philadelphia, Pa. . . Apr. 27, 1898.
Louis I. Guion . . . . Supt. Columbia Mills Co., Box 130 . Columbia, S. C. . . . Oct. 2, 1902.
Arthur H. Gulliver . . Supt. Samoset Co. . . . . Valley Falls, R. I. . . Apr. 24, 1889.

William J. Hadfield . . Newburgh Steam Mills, ...
. . . . . 124 Smith St., Newburgh, N. Y. . . Apr. 27, 1899.
Frank J. Hale . . . . Gen. Agt. Saco and Pettee Machine Shops . . . . . .
. . . . . Newton Upper Falls, Mass. . Apr. 27, 1892.
Walter B. Hall . . . . Supt. Pontaic Mill, B. B. & R. Knight, Pontiac R. I. . . . Apr. 25, 1901.
William E. Hall . . . Treas. and Mgr. Shaw Stocking Co., Lowell, Mass. . . . Apr. 27, 1892.
Z. D. Hall . . . . . Supt. Berkshire Cotton Mfg. Co. . . . . .
. . . . . 70 Orchard St., P. O. Box 963, Adams, Mass. . . . Oct. 29, 1879.
William Halliwell, . . Agt. Providence and Woonsocket Mills of the Lawton Spin-
. . . . . ning Co., Woonsocket, R. I. . Sept. 26, 1901.
John H. Hambly . . . Treas. Quidnick Manufg. Co. . . . . .
. . . . . 49 Westminster St., Providence, R. I. . . Apr. 24, 1895.
Arthur M. Hamilton . . Supt. Hargraves and Parker Mills . . . . . .
. . . . . 267 Hanover St., Fall River, Mass. . . Apr. 28, 1897.
John F. Hamlet . . . Manufacturer . . . P. O. Box 160, Fall River, Mass. . . Oct. 31, 1888.
Peter Hardman . . . Supt. American Thread Co., Willimantic Mills . . . . . .
. . . . . Willimantic, Conn. . Apr. 23, 1903.
A. G. Harris . . . . . West Warren Cotton Mills, ... West Warrren, Mass. Sept. 26, 1901.
Henry F. Harris . . . Treas. West Boylston Manufg. Co. . . . . .
. . . . . 340 Main St., Worcester, Mass. . . Apr. 30, 1890.
Charles E. Harrison . . Mgr. Harrison Yarn & Dyeing Co. Pawtucket, R. I. . . Sept. 22, 1904.
W. G. Hartford . . . . . Box 37, Longmeadow, R. I. . Apr. 23, 1903.
Frank Hartley . . . . Supt. S. Slater & Sons . . . . . Webster, Mass, . . . Apr. 27, 1905.

William D. Hartshorne Agt. Arlington Mills . . . . . Lawrence, Mass. . . Apr. 27, 1899.
Walter M. Hastings . . Asst. Agt. Arlington Mills . . . . . Lawrence, Mass. . . Apr. 23, 1903.
Chester D. Hatch . . Agt. Exeter Mfg. Co., ... Exeter N. H. . . . . Apr. 28, 1904.
William E. Hatch . . Pres. New Bedford Textile School, ... 166 William St., New Bedford, Mass. . Sept. 22, 1904.
William Hathaway . . Supt. Barnard Manufg. Co. . . . . Fall River, Mass. . . Apr. 25, 1894.
William B. Hawes . . Yarn Broker . . . 108 Bedford St., ... P. O. Box 733, Fall River, Mass. . . Apr. 24, 1895.
Alfred Hawkesworth . Supt. Merchants' Cotton Co. . . . . Montreal, P. Q. . . . Apr. 26, 1893.
Fred Hawkesworth . . Asst. Supt. Merchants' Cotton Co. . Montreal, P. Q. . . . Sept. 22, 1896.
William Hayes . . . . Agt. Barker Mill . . . . . Auburn, Me. . . . . Apr. 30, 1879.
W. G. Henderson . . . Agt. Falls Co. . . . . Norwich, Conn. . . . Apr. 29, 1896.
A. E. Henry, ... Mfr. Partner in Solway Mills, . . . Westerly, R. I. . . . Apr. 25, 1901.
James Henry . . . . . Thos. Henry & Sons . . . . . Trenton Ave. and Tioga St., Philadelphia, Pa. . . Oct. 1, 1903.
William G. Henry . . Thos. Henry & Sons . . . . . Trenton Ave. and Tioga St., Philadelphia, Pa. . . Oct. 1, 1903.
Arthur N. Hersom, ... 221 Foster St., Lowell, Mass. . . . Apr. 28, 1904.
Ernest L. Hersom . . Supt. Nockege Mill . . . . . Fitchburg, Mass. . . Apr. 23, 1903.
T. I. Hickman, ... Pres. and Treas. Graniteville Mfg. Co. . . . . Leonard Bldg., Augusta, Ga. . . . . Apr. 25, 1901.
Hiram Higham . . . . Supt. 6 and 7 Wamsutta Mills . . . New Bedford, Mass. . Oct. 1, 1903.
Ernest L. Hill . . . . Treas. Renfrew Mfg. Co. . . . . Adams, Mass. . . . Apr. 24, 1902.
William H. Hill . . . Pres. Renfrew Mfg. Co., 40 Water St., Boston, Mass. . . . Apr. 24, 1902.
George H. Hills . . . Treas. Davol Mills & Stevens Mfg. Co., Fall River, Mass. . . Oct. 25, 1895.
Alexander F. Hobbs . . Asst. Mgr. U. S. Finishing Co. . . . Norwich, Conn. . . . Apr. 27, 1905.
Charles H. Hobbs . . Agt. Thorndike Co. . . . . Thorndike, Mass. . . Apr. 28, 1886.
Franklin W. Hobbs . . Treas. Arlington Mills . . . . . P. O. Box 5317, 78 Chauncy St., Boston, Mass. . . . Apr. 27, 1899.
William Henry Hobbs . Asst. Supt. Johnson & Johnson Co., New Brunswick, N. J. Apr. 24, 1902.
Charles M. Holmes . . Agt. Manomet Mills, ... Box 96, New Bedford, Mass. . Apr. 27, 1899.
Gideon F. Holmes . . Treas. and Gen. Mgr. Plymouth Cor- . . . . . dage Co. . . . . No. Plymouth, Mass. . Oct. 30, 1889.
George W. Holt . . . Agt. Monohansett Manufg. Co. . . Putnam, Conn. . . . Oct. 29, 1879.
John H. Holt . . . . Supt. Luther Mfg. Co. . . . . Fall River, Mass. . . Apr. 23, 1903.
Walter L. Holt . . . . Pres. Holt-Morgan Mills . . . . . Fayetteville, N. C. . . Oct. 18, 1900.
William P. Holt . . . Supt. Barnaby Mills . . . . . Fall River, Mass. . . Oct. 25, 1893.
Wm. E. Hooper . . . Mgr. Woodberry Div. of Mt. Vernon Woodberry Co. . . . . 15 East Franklin St., Baltimore, Md. . . . Apr. 23, 1903.
H. B. Hopson . . . . Supt. Spool Cotton Dept., Bibb Mfg. Co. . . . . Box 98, Macon, Ga. . . . . Apr. 28, 1904.
Edward W. Houghton . Supt. Globe Mill . . Manville Co., Woonsocket, R. I. . . Apr. 24, 1902.
Henry S. Houghton, Jr. Merchants Cotton Co. . . . . Montreal, P. Q. . . . Apr. 24, 1895.
W. C. Houston . . . . Pres. Hope Mills Manufg. Co. . . . . 333 Drexel Building, Philadelphia, Pa. . . Apr. 28, 1897.
Elisha H. Howard . . Cotton Goods Broker, 20 Market Sq., Providence, R. I. . . Apr. 25, 1883.

Henry S. Howe . . . Dry Goods Commission . . . . . 89 Franklin St., Boston, Mass. . . . Oct. 31, 1877.
Albert C. Hoy . . . . . Woonsocket, R. I. . . Apr. 27, 1898.
Charles W. Hubbard . Treas. and Sec. Ludlow Mfg. Associates . . . . . 133 Essex St., Boston, Mass. . . . Apr. 25, 1901.
Otis L. Humphrey, . . Harding, Whitman, & Co., 78 Chauncy St., Boston, Mass. Apr. 25, 1901.
Arthur W. Hunking . . . . . 374 Stevens St., Lowell, Mass. . . . Apr. 24, 1895.

D. Edwin Irving . . . Treas. The Irving & Leiper Mfg. Co., Chester, Pa. . . . . Oct. 28, 1897.

Earl S. Jenckes . . . . Supt. Paul Whitin Mfg. Co. . . . . Northbridge Mass. . . Apr. 27, 1905.
J. E. Jenckes . . . . . Treas. E. Jenckes Manufg. Co. & E. Jenckes Spinning Co. . . . . Pawtucket, R. I. . . Apr. 24, 1895.
Edward B. Jennings . . Treas. Samoset Co. . . . . Valley Falls, R. I. . . Sept. 29, 1898.
David L. Jewell . . . Agt. China, Webster & Pembroke Mills . Suncook, N. H. . Apr. 20, 1865.
Leonard Johnson . . . Supt. Wampanoag Mills . . . . . 33 Cambridge St., Fall River, Mass. . . Oct. 1, 1903.
David S. Johnston . . Gen. Supt. Harmony Mills . . . . Cohoes, N. Y. . . . Oct. 28, 1891.
Gordon A. Johnstone . Agt. Danielson Cotton Co. . . . . Danielson, Conn. . . Apr. 23, 1903.
W. T. Jordan . . . . Mgr. Mountain Island Mfg. Co. . . Mountain Island, N. C. Oct. 25, 1895.

W. E. Keach . . . . . Supt. Grant Yarn Co., 21 Burnap St., Fitchburg, Mass. . . Oct. 26, 1892.
Roland R. Kelly . . . Supt. Williamstown Manufg. Co. . Williamstown Sta., Mass. Nov. 30, 1881.
Hervey Kent . . . . . Pres. Exeter Manufg. Co. . . . . Exeter, N. H. . . . Apr. 20, 1865.
Nathaniel B. Kerr . . . Treas. Butler Mill . . . . . New Bedford, Mass. . Oct. 26, 1892.
Harry W. Kimball . . Riverside Cotton Mills . . . . . Danville, Va. . . . . Oct. 25, 1895.
William N. Kimball . . Supt. Social and Nourse Mills, Manville Co. . . . . Woonsocket, R. I. . . Apr. 24, 1902.
Alexander King Jr. . . Asst. Supt. American Thread Co. . Holyoke, Mass . . . . Apr. 27, 1905.
Emil Kipper . . . . . Vice Pres. Windsor Print Works . . Adams, Mass. . . . . Apr. 24, 1902.
John T. Kirk . . . . . Supt. Slater Cotton Co., Box 697 . . Pawtucket, R. I. . . . Apr. 27, 1905.
Albert F. Knight . . . Mfr. Fine White Cotton Goods and Yarns . . . . . Box 835, Providence, R. I. . . Oct. 27, 1886.
Jesse A. Knight . . . . Supt. Cohannet Mills . . . . . Taunton, Mass. . . . Oct. 26, 1892.
Stephen A. Knight . . Pres. Hebron Manufg. Co., Box 820, Providence, R. I. . . Oct. 21, 1868.
Walter B. Knight . . . . . Davisville, R. I. . . . Apr. 24, 1889.
Webster Knight . . . B. B. & R. Knight's Mills . . . . . 3 Washington Row, Providence, R. I. . . Oct. 31, 1888.
John Kniveton . . . . Instr. Weaving and Warp Preparation, ... Bradford Durfee Textile School, Fall River, Mass., . . Sept. 22, 1904.

Fred Lacey . . . . . Mgr. Montreal Cotton Co. . . . . Valleyfield, P. Q. . . Apr. 24, 1895.
Elliott Cowdin Lambert Supt. Amoskeag Manufg. Co. . . . Manchester, N. H. . Oct. 25, 1895.
William T. Lang . . . Agt. Brookside Mills . . . . . Knoxville, Tenn. . . Apr. 28, 1897.
Walter H. Langshaw . Agt. Dartmouth Manufg. Corp. . . New Bedford, Mass. . Apr. 29, 1896.

Harold Lawton . . . . Mgr. Baltic Mills Co. . . . . Baltic, Conn. . . . . Oct. 27, 1886.
John Edward Lawton . Governing Director American Thread Co., ... Matlock, Derbyshire, England . Apr. 25, 1901.
J. H. Ledyard . . . . Asst. Gen. Mgr. Meridian Cotton Mills, Meridian, Miss. . . . Sept. 22, 1904.
Calvin H. Lee . . . . Supt. Readville Cotton Mills . . . Hyde Park, Mass. . . Apr. 24, 1902.
Evan Arthur Leigh . . Textile Machinery 232 Summer St., Boston, Mass. . . . . Oct. 29, 1890.
J. Colby Lewis . . . . . Salmon Falls, N. H. . Oct. 26, 1892.
Charles F. Libby . . . Supt. Shaw Stocking Co. . . . . Lowell, Mass. . . . Apr. 24, 1902.
Leontine Lincoln . . . Pres. Seaconnet Mills . . . . . Fall River, Mass. . . Apr. 28, 1897.
B. F. G. Linnell . . . Commission Merchant, Yarns, Threads and Twines . . . . . 37 Summit St., P. O. Box 645, Central Falls, R. I. . . Oct. 28, 1897.
Henry F. Lippitt . . . Gen. Mgr. Manville Cos., ... Providence, R. I. . . . Apr. 27, 1881.
William H. Loftus . . Supt. Clark Thread Co. . . . . Newark, N. J. . . . Oct. 28, 1897.
Harry D. Lord . . . . Instr. Carding and Spinning, Mississippi Textile School, ... Agricultural College, Miss. . . . . Apr. 27, 1905.
John T. Lord, ... Supt. Pacific Mills, ... Lawrence, Mass. . . Apr. 28, 1904.
Robert W. Lord . . . Agt. R. W. Lord & Co. . . . . Kennebunk, Me. . . Oct. 20, 1869.
Ernest Lovering . . . Agt. Lyman Mills . . . . . Holyoke, Mass. . . . Apr. 25, 1888.
Henry M. Lovering . . Agt. Whittenton Manufg. Co. . . . Taunton, Mass. . . . Oct. 27, 1880.
William C. Lovering . Pres. Whittenton Manufg. Co. . . . . 50 State St., Boston, Mass. . . . Oct. 25, 1876.
William M. Lovering . Lawrence & Co., ... 24 Thomas St. New York, N. Y. . . Sept. 27, 1894.
Arthur H. Lowe . . . Treas. Parkhill Mfg. Co., Treas. Wm. Lowe Mfg. Co., ... Huntsville, Ala. . . . . Fitchburg, Mass. . . Oct. 30, 1889.
David Lowe . . . . . Supt. Parkhill Manufg. Co. . . . . Fitchburg, Mass. . . Apr. 24, 1895.
Charles B. Luther . . . Treas. Luther Mfg. Co. . . . . Fall River, Mass. . . Sept. 22, 1904.
Dudley T. Lyall . . . Sec. Brighton Mills . . . . . Passaic, N. J. . . . . Sept. 22, 1896.
William L. Lyall . . . Treas. Brighton Mills . . . . . Passaic, N. J. . . . . Oct. 26, 1892.
Herbert Lyman . . . . . 39 Beacon St., P. O. Box 1717, Boston, Mass. . . . Oct. 25, 1895.
Ronald T. Lyman . . . Asst. Treas. Boston Mfg. Co. . . . . P. O. Box 1717, Boston, Mass. . . . Oct. 1, 1903.
Otis G. Lynch . . . . Supt. Enterprise Manufg. Co. . . . Augusta, Ga. . . . . Oct. 25, 1895.
Alvin S. Lyon . . . . Supt. Bigelow Co. . . . . Lowell, Mass. . . . Apr. 26, 1882.

James R. MacColl . . Treas. Lorraine Manufg. Co. . . . Pawtucket, R. I. . . Apr. 24, 1895.
Charles L. Macomber . Pres. Winthrop Cotton Yarn Co. . . Taunton, Mass. . . . Apr. 24, 1895.
Frederick B. Macy, . . Treas. Soule Mills, ... New Bedford, Mass. . Apr. 25, 1901.
Amos G. Maddox . . . Supt. Linwood Mill . . . . . Linwood, Mass. . . . Oct. 18, 1900.
Charles T. Main . . . Mech. and Mill Engineer, Dean & Main . . . . . 53 State St., 1112 Exchange Bldg., Boston, Mass. . . . Oct. 28, 1885.
Alexander Makepeace . Supt. Richard Borden Mfg. Co. . . Fall River, Mass. . . Oct. 1, 1903.
Charles R. Makepeace . Mill Engineer . . . . . Box 973, Providence, R. I. . . Apr. 30, 1890.
Vladimir Malinin, M. E., Prochoroff Three Hill Mfg. Co. . . Moscow, Russia . . . Apr. 23, 1903.
J. D. Mallory . . . . Supt. John M. Stone Cotton Mill . . Starkville, Miss. . . . Apr. 27, 1905.
Arthur B. Mann . . . J. H. Martin & Co., 99 Franklin St., New York, N. Y. . . Apr. 25, 1894.

Charles H. Manning	Supt. Amoskeag Manufg. Co.	Manchester, N. H.	Oct. 28, 1885.
Henry F. Mansfield	Gen. Supt. Utica Steam Cotton Mills and Mohawk Valley Cotton Mills	Utica, N. Y.	Apr. 30, 1890.
Paul J. Marrs	Treas. Henderson Cotton Mills	Henderson, Ky.	Oct. 28, 1897.
Albert G. Martin	Supt. Kincaid Manufg. Co.	Box 182, Griffin, Spalding County, Ga.	Apr. 30, 1884.
Henry D. Martin	Mgr. I. E. Palmer's Cot. Spin. Mill	Middletown, Conn.	Apr. 28, 1897.
Arthur H. Mason	Treas. Davis Mills	Fall River, Mass.	Oct. 2, 1902.
Philip A. Mathewson	Supt. King Philip Mills	Box 607, Fall River, Mass.	Apr. 24, 1895.
Scott Maxwell,	Agt. Indian Head Mills of Ala.	Cordova, Ala.	Sept. 26, 1901.
Thomas Mayor	Textile Machinery	Thomas Mayor & Son, 26 Olney St., Providence, R. I.	Oct. 27, 1880.
Andrew W. McAllister	Supt. Natick Mills,	Natick, R. I.	Apr. 28, 1904.
Robert McArthur	Agt. Pepperell Mfg. Co.	Biddeford, Me.	Apr. 17, 1872.
Thos. McAuliffe	Supt. Stevens Mfg. Co.	Fall River, Mass.	Apr. 27, 1898.
Albert E. McDonald	Agt. Lawrenceville Mfg. Co.,	Lawrenceville, Ga.	Oct. 2, 1902.
Fred C. McDuffie	Treas. Everett Mills and York Manufg. Co.	P. O. Box 2934, Boston, Mass.	Oct. 25, 1882.
John G. McFadden	Supt. Nottingham Mill, 314 Dyer St.,	Providence, R. I.	Oct. 1, 1903.
James A. McLane	Supt. Davis Mills	Fall River, Mass.	Oct. 2, 1902.
William G. McLoon	Supt. Lancaster Mills,	Clinton, Mass.	Apr. 27, 1892.
Robert G. McMeehan,	Supt. Uncasville Mfg. Co.	Uncasville, Conn.	Sept. 26, 1901.
William P. McMullan	Agt. Naumkeag Steam Cotton Co.	Salem, Mass.	Sept. 27, 1894.
John Tempest Meats	Agt. Mason Machine Works	Taunton, Mass.	Apr. 27, 1887.
Robert B. Meikle	Supt. Lorraine Mfg. Co.	Westerly, R. I.	Apr. 23, 1903.
Henry P. Meikleham,	Agt. Mass. Mills in Georgia	Lindale, Floyd Co., Ga.	Apr. 26, 1900.
Joseph Mercer	Agt. and Treas. Willimantic Cotton Mills Co.	Willimantic, Conn.	Apr. 24, 1902.
Charles H. Merriman, Jr.	Manville Co., Board of Trade Bldg.,	Providence, R. I.	Apr. 24, 1895.
Joseph Merriam	Pres. Springfield Webbing Co.	Middletown, Conn.	Oct. 2, 1902.
R. M. Miller, Jr.	Pres. & Treas. Elizabeth Mills	Charlotte, N. C.	Sept. 29, 1898.
James I. Milliken	Agt. Everett Mills	Lawrence, Mass.	Oct. 26, 1892.
Roscoe S. Milliken	Agt. Nashua Mfg. Co.	Nashua, N. H.	Apr. 29, 1896.
David Milne	C. J. Milne & Sons	Washington Ave. & 10th and 11th Sts., Philadelphia, Pa.	Apr. 28, 1897.
A. B. Mole	Gen. Mgr. Dominion Cotton Mills Co.,	Montreal, P. Q.	Apr. 24, 1895.
Edward A. Mongeon	Supt. Lonsdale Mills	Lonsdale, R. I.	Apr. 24, 1895.
George M. Montgomery	Vice Pres. The J. R. Montgomery Co.	Windsor Locks, Conn.	Sept. 22, 1904.
J. R. Montgomery	Pres. The J. R. Montgomery Co.	Windsor Locks, Conn.	Sept. 29, 1898.
George A. Moody	Supt. West Warren Cotton Mills	West Warren, Mass.	Apr. 27, 1899.
Fred W. Moore	Agt. Cordis Mills	P. O. Box 582, Millbury, Mass.	Apr. 27, 1892.
George B. Morison	Pres. Ballou Yarn Co.,	77 Summer St., Boston, Mass.	Apr. 24, 1895.
Albert H. Morton	Supt. Kitson Machine Co.	Lowell, Mass.	Oct. 28, 1891.
E. P. Morton,	Agt. Stevens Linen Works	Webster, Mass.	Sept. 26, 1901.
Oliver H. Moulton	Supt. Hamilton Manufg. Co.	Lowell, Mass.	Apr. 20, 1865.
Harold Mowry	Mgr. Sterling Branch U. S. Finishing Co.	Sterling, Conn.	Apr. 27, 1905.

Farquharson J. Muir	Cone Export & Commission Co.	Greensboro, N. C.	Apr. 27, 1892.
William Myers	Supt. Technical School, Sunny Bank, Stone Edge, Marple, Cheshire, Manchester, England		Sept. 22, 1904.
John Neild	Agt. Grinnell Mfg. Corp.	New Bedford, Mass.	Apr. 25, 1901.
Will Nelson	Head Instructor of Weaving, Lowell Textile School	Lowell, Mass.	Apr. 23, 1903.
Roscius C. Newell	Supt. Palmer Mill	Three Rivers, Mass.	Oct. 25, 1895.
H. W. Nichols	Supt. New Bedford Textile School	New Bedford, Mass.	Sept. 22, 1904.
William G. Nichols	Sec. and Treas. Springstein Mills and Pres. Wylie Mills	Chester, S. C.	Oct. 25, 1893.
William M. Nixon	Pres. Atlanta Woolen Mills	Atlanta, Ga.	Oct. 5, 1899.
Albert W. Noone,	Prop. & Mgr. Jos. Noone's Son's Co.	Peterboro, N. H.	Sept. 26, 1901.
Franklin Nourse	Agt. Lawrence Manufg. Co.	Lowell, Mass.	Apr. 24, 1878.
S. Odenheimer	Treas. Lane Mills	New Orleans, La.	Oct. 25, 1893.
Charles K. Oliver	Pres. U. S. Duck Corporation	Baltimore, Md.	Sept. 27, 1894.
William B. Orr,	Supt. RenfrewMfg. Co.	Adams, Mass.	Apr. 28, 1904.
J. Edward Osborn	Treas. American Linen Co.	Fall River, Mass.	Apr. 28, 1897.
Henry Osgood,	6 Monroe St., P. O. Box 204,	Salem, Mass.	Apr. 25, 1901.
Frederick Ott	Supt. Hamlet Textile Co.	Woonsocket, R. I.	Apr. 23, 1903.
Herbert W. Owen	Supt. Cocheco Mfg. Co.	Dover, N. H.	Oct. 5, 1899.
Logan Owen	Supt. Mill No. 1, Bibb Mfg. Co.,	Macon, Ga.	Apr. 28, 1904.
Oscar L. Owen	Mech. and Mill Eng. Whitin Machine Works	Whitinsville, Mass.	Apr. 25, 1894.
Elmer E. Page	Agt. York Manufg. Co.	Saco, Me.	Apr. 27, 1892.
Walter H. Paige	Supt. Wamsutta Mills	New Bedford, Mass.	Oct. 1, 1903.
O. B. Parker	Supt. Quidnick Mfg. Co.	Quidnick, R. I.	Apr. 24, 1895.
Samuel L. Parker	Supt. Turners Falls Cotton Mills Box 627,	Turners Falls, Mass.	Apr. 29, 1896.
Duncan D. Parmly	Treas. Johnson Mfg. Co. and Dunbar Mills Co. 160 Broadway,	New York, N. Y.	Sept. 22, 1896.
Samuel F. Patterson	Pres. and Treas. Thistle Mills Co.	Ilchester, Md.	Oct. 18, 1900.
Arthur H. Paul	Asst. Supt. Boston Mfg. Co.	Waltham, Mass.	Apr. 27, 1905.
John W. Pead	305 Andover St.	Lowell, Mass.	Apr. 26, 1893.
James R. Pearce		Pell City, Ala.	Oct. 25, 1895.
William C. Peirce	Pres. Elizabeth Mills . 564 Eddy St.,	Providence, R. I.	Apr. 24, 1895.
William D. Pennell	Agt. Hill Manufg. Co.	Lewiston, Me.	Apr. 16, 1873.
Haven C. Perham	Treas. Kitson Machine Co.	Lowell, Mass.	Apr. 30, 1879.
Hadley D. Perkins	Mem. firm Sharp, Perkins & Co., Handkerchief Mfrs.	Woonsocket, R. I.	Apr. 28, 1904.
Henry C. Phillips	Asst. Gen. Supt. Harmony Mills	Cohoes, N. Y.	Apr. 25, 1894.
Benjamin Phipps	Merchant . 4 Winthrop Sq.	Boston, Mass.	Sept. 29, 1898.
Albert R. Pierce	Supt. Pierce Mfg. Corp.	New Bedford, Mass.	Oct. 5, 1899.

Andrew G. Pierce, Jr.	Treas. Pierce Manufg. Corp. P. O. Box 34,	New Bedford, Mass.	Apr. 24, 1895.
Charles H. Plummer	Agt. Great Falls Manufg. Co.,	Somersworth, N. H.	Apr. 25, 1888.
Charles T. Plunkett	Sec. Berkshire Cotton Mfg. Co.	Adams, Mass.	Apr. 28, 1897.
William C. Plunkett	Mgr. W. C. Plunkett & Sons	Adams, Mass.	Oct. 1, 1903.
Charles H. Potter,	Supt. Montreal Cotton Co.,	Valleyfield, P. Q.,	Apr. 25, 1901.
Joseph H. Potter, Jr.	Supt. Durfee Mills	Fall River, Mass.	Apr. 27, 1899.
J. F. Powers	Supt. Spinning Mill	Middletown, Conn.	Oct. 5, 1899.
Lavater W. Powers	Supt. Bristol Mfg. Co. 141 Merrimac St.,	New Bedford, Mass.	Oct. 1, 1903.
Albert S. Pratt	Agt. Edwards Mfg. Co.	Augusta, Me.	Apr. 27, 1905.
Herbert L. Pratt	Agt. Bates Manufg. Co.	Lewiston, Me.	Oct. 27, 1875.
George E. Prest	340 Highland St., Newton Square,	Worcester, Mass.	Apr. 24, 1902.
John E. Prest	340 Highland St., Newton Square,	Worcester, Mass.	Apr. 17, 1872.
M. W. Quinn	Agt. Hamilton Woolen Co.	Amesbury, Mass.	Oct. 27, 1886
John W. Ramsbottom	Supt. Brighton Mills,	Passaic N. J.	Apr. 24, 1902.
Theodore Ellis Ramsdell,	Gen. Supt. Monument Mills	Housatonic, Mass.	Apr. 23, 1903.
Emory S. Rathburn		Danielson, Conn.	Apr. 27, 1899.
M. A. Rawlinson	Supt. Chicopee Mfg Co.	Chicopee Falls., Mass.	Apr. 24, 1895.
John F. Reardon	Supt. Millville Mfg. Co.	Millville, N. J.	Apr. 26, 1900.
Robert Redford	Mfr. Box 28,	Lawrence, Mass.	Apr. 26, 1882.
R. S. Reinhardt	Treas. and Mgr. Elm Grove Cotton Mills	Lincolnton, N. C.	Apr. 27, 1898.
T. H. Rennie	Supt. Graniteville Mfg. Co.	Graniteville, S. C.	Oct. 18, 1900.
Frederick W. Reynolds,	Supt. Potomska Mills, Box 299, 20 Fifth St.,	New Bedford, Mass.	Apr. 26, 1900.
Francis H. Rice	Pres. Holbrook Mills	Millbury, Mass.	Apr. 28, 1880.
John Bion Richards	Treas. Davis Mills	Fall River, Mass.	Apr. 24, 1902.
Charles H. Richardson	Agt. Lancaster Mills	Clinton, Mass.	Apr. 24, 1889.
Harry J. Ricketson,	Supt. Merchants' Mfg. Co.	Fall River, Mass.,	Apr. 28, 1904.
Walter Rigby	Bibb Mfg. Co. 3163 First Ave.,	Columbus, Ga.	Apr. 26, 1900.
Charles E. Riley	Textile Machinery, C. E. Riley & Co. 65 Franklin St., Box 2815,	Boston, Mass.	Apr. 25, 1888.
William H. Ritter	Gen. Supt. and Buyer Johnson & Johnson 266 George St.,	New Brunswick, N. J.	Apr. 26, 1900.
Benj. H. Roberts	General Mill Supplies 163 Grove St.,	Fall River, Mass.	Apr. 26, 1900.
Charles D. Robinson	Supt. Crompton Co.	Crompton, R. I.	Sept. 27, 1894.
William H. Robinson	Supt. No. 3 Harmony Mill	Cohoes, N. Y.	Apr. 24, 1902.
John J. Rooney	Asst. Supt. Tremont & Suffolk Mills 151 Cabot St.,	Lowell, Mass.	Apr. 27, 1905.
W. H. Rose	Sec'y & Treas. Richland, Granby and Olympia Cotton Mills	Columbia, S. C.	Oct. 18, 1900.
Henry Rowe,	166 Holland St.,	Lewiston, Me.	Apr. 28, 1904.
Lewis H. Russell	Supt. Ansonia Co.	Ansonia, Conn.	Apr. 27, 1905.

Alfred Sagar	Supt. Arlington Cotton Mills 15 High St.,	Methuen, Mass.	Apr. 24, 1902.
Edward H. Sanborn	Vice Pres. Cold Spring Bleaching and Finishing Works 305 Betz Bldg.,	Philadelphia, Pa.	Oct. 18, 1900.
J. N. Sanderson	Agt. Renfrew Mfg. Co.,	Adams, Mass.,	Apr. 28, 1904.
Arnold B. Sanford	Pres. Kennebec Spinning Mills 67 Chauncy St.,	Boston, Mass.	Oct. 25, 1882.
Pardon B. Sanford	Supt. Yarn Dept. Utica Knitting Co.,	Utica, N. Y.	Oct. 2, 1902.
J. Herbert Sawyer	93 Federal St.,	Boston, Mass.	July 19, 1865.
Arnold Schaer	Agt. Warren Manufg. Co.	Warren, R. I.	Apr. 24, 1895.
Albert E. Schofield	Delph Spinning Co. Clearfield and C Sts.,	Philadelphia, Pa.	Oct. 1, 1903.
Theodore C. Search	Pres. Cold Spring Bleaching and Finishing Works	Yardley, Pa.	Oct. 18, 1900.
Albion K. Searls	Supt. Yarn Dept., Oneita Knitting Mills 241 South St.,	Utica, N. Y.	Apr. 24, 1902.
Charles M. Sears	Supt. Harmony Grove Cotton Mills	Commerce, Ga.	Apr. 27, 1898.
George H. Shapley	Treas. Silver Lake Co., 78 Chauncy St.	Boston, Mass.	Apr. 29, 1896.
Frank P. Sheldon	Mill Engineer and Architect, 49 Westminster St. Industrial Trust Bldg.	Providence, R. I.	Apr. 25, 1894.
Thomas C. Sheldon	Agt. Fitchburg Duck Mills 8 School St.,	Fitchburg, Mass.	Oct. 29, 1884.
Willis S. Shepard	Pres. American Net and Twine Co.	Ponkapoag, Mass.	Apr. 29, 1896.
William F. Sherman	Mill Engineer 294 Washington St.,	Boston, Mass.	Apr. 15, 1874.
Charles M. Shove	Treas. Granite Mills Box 45,	Fall River, Mass.	Oct. 27, 1875.
W. Frank Shove	Treas. Pocasset Mfg. Co., Fall River Mfg. Co., Fall River, Mass. and Windham Mfg. Co., Willimantic, Conn.	Fall River, Mass.	Sept. 22, 1904.
Herbert H. Shumway	Treas. and Agt. Corr Manufg. Co.	Taunton, Mass.	Apr. 26, 1893.
Francis H. Silsbee	Supt. Cotton Dept. Pacific Mills	Lawrence, Mass.	Apr. 7, 1887.
Nathaniel G. Simonds	Treas. Naumkeag Steam Cotton Co.,	Salem, Mass.	Apr. 27, 1898.
Louis Simpson	Victoria Chambers,	Ottawa, Ont.	Apr. 24, 1895.
Abbott E. Slade	Treas. Laurel Lake Mills 863 High St.,	Fall River, Mass.	Oct. 25, 1893.
Arthur T. Smith	Supt. Langley Manufg Co. / Supt. Aiken Manufg. Co.	Langley, S. C.	Oct. 25, 1895.
James Herbert Smith	Supt. Quinebaug Co.	Danielson, Conn.	Apr. 27, 1898.
Joel Smith	1311 15th St.	Augusta, Ga.	Oct. 25, 1895.
J. C. Smith	Supt. Chace Mills	Fall River, Mass.	Oct. 28, 1897.
Stephen E. Smith	Cotton Dept. Lowell Textile School,	Lowell, Mass.	Apr. 27, 1905.
Thomas Henry Smith	Jamestown Cotton Mill	Jamestown, N. Y.	Apr. 30, 1884.
Rufus A. Soule	Pres. Soule Mill & City Mfg. Cor.	New Bedford, Mass.	Apr. 28, 1904.
William S. Southworth	Agt. Mass. Cotton Mills	Box 1230, Lowell, Mass.	Oct. 31, 1888.
Wilton H. Spencer	Textile Manuf.,	7 Exchange Pl., Providence, R. I.	Apr. 27, 1898.
George E. Spofford	Supt. Blackstone Mfg. Co.	Blackstone, Mass.	Apr. 29, 1896.
Henry B. Sprague	Treas. Boston Woven Hose and Rubber Co.	Lynn, Mass.	Oct. 5, 1899.

Leroy Springs	Pres. Lancaster Cotton Mills	Lancaster, S. C.	Oct. 25, 1895.
George R. Stearns	Pres. Riverside Mills	Augusta, Ga.	Apr. 30, 1890.
T. B. Stevenson	Supt. Manchaug Co.	Manchaug, Mass.	Apr. 26, 1900.
Robert Stewart	Asst. Supt. Lonsdale Co.	Ashton, R. I.	Apr. 27, 1899.
Samuel Stewart	Supt. Boston Duck Co.	Bondsville, Mass.	Apr. 23, 1903.
William J. Stewart	Supt. S. Slater & Sons, Inc.	Webster, Mass.	Apr. 23, 1903.
Walter F. Stiles	Treas. Orswell Mills	Fitchburg, Mass.	Oct. 25, 1895.
O. W. Stites	Supt. Louisville Cot. Mills Co.	Louisville, Ky.	Oct. 25, 1895.
Henry Wm. Stone	Supt. Holliston Mills	Norwood, Mass.	Apr. 28, 1904.
B. L. Stowe	Vice-Pres. Eureka Fire Hose Co. Wilkinson and Arlington Aves.,	Jersey City, N. J.	Sept. 26, 1901.
Herman F. Straw	Agt. Amoskeag Manufg. Co. & Manchester, Mills.	Manchester, N. H.	Oct. 28, 1885.
John Sullivan	Care C. E. Riley, & Co.,	65 Franklin St. Boston, Mass.	Apr. 27, 1899.
Timothy Sullivan	Supt. Stafford Mills	Fall River, Mass.	Apr. 27, 1899.
Walter H. Summersby	Agt. Atlantic Cotton Mills	Lawrence, Mass.	Oct. 25, 1893.
James O. Sweet	Agt. and Treas. Ashland Cotton Co.	Jewett City, Conn.	Apr. 28, 1886.

Charles A. Tabor	Supt. Thorndike Mills,	Thorndike, Mass.	Apr. 27, 1905.
Robert W. Taft	Treas. Coventry Co. and Bernon Mills	Box 1144, Providence, R. I.	Sept. 27, 1894.
George P. Taylor		286 Chestnut St., Clinton, Mass.	Oct. 27, 1880.
James W. Taylor		Box 46, Taunton, Mass.	Oct. 26, 1892.
Samuel Taylor	Supt. Soule Mill	New Bedford, Mass.	Oct. 1, 1903.
W. Marshall Taylor	Gen. Mgr. National Flax Fibre Co.	Box 327, Millis, Mass.	Sept. 22, 1896.
Richard Thackeray	Supt. Weetamoe Mills	Fall River, Mass.	Apr. 29, 1885.
S. Willard Thayer	Treas. Dexter Yarn Co.	Pawtucket, R. I.	Sept. 26, 1901.
Berton A. Thissell	Supt. Boott Cotton Mills	Lowell, Mass.	Oct. 1, 1903.
Earl A. Thissell	Treas. Lowell Hosiery Co.	Lowell, Mass.	Oct. 30, 1878.
Ariel C. Thomas	Agt. Boott Cotton Mills	62 Mt. Vernon St., Lowell, Mass.	Oct. 31, 1888.
Charles E. Thomas	Treas. Forestdale Manufg. Co.	44 Prospect St., Woonsocket, R. I.	Oct. 31, 1883.
Edward W. Thomas	Supervising Eng. U. S. Duck Co.	Baltimore, Md.	Apr. 30, 1884.
Charles R. Thomson	Asst. Gen. Renfrew Co.	Adams, Mass.	Apr. 27, 1905.
D. M. Thompson	Pres. F. W. Reynolds Co.,	Providence, R. I.	Oct. 28, 1885.
James O. Thompson, Jr.	Supt. Wampanoag Mills	Fall River, Mass.	Oct. 18, 1900.
Ralph E. Thomson	Supt. Parkhill Manufg. Co., Mill C.	Fitchburg, Mass.	Apr. 25, 1894.
R. Irving Tobey		Lousdale, R. I.	Oct. 2, 1902.
W. O. Todd	Sec. and Treas. Lawton Spinning Co.	Box 1125, 621 Banigan Building, Providence, R. I.	Oct. 18, 1900.
James P. Tolman	Pres. Samson Cordage Works	115 Congress St., Boston, Mass.	Oct. 29, 1890.

Daniel A. Tompkins . Pres. and Eng. D. A. Tompkins Co. Charlotte, N. C. . . . Oct. 25, 1895.
M. J. Toohey . . . . Mfr. Rope, Twine and Banding . . . . . 809 Stafford Rd., Fall River, Mass . . Oct. 2, 1902.
George W. Towne . . . Mgr. Columbus Power Co. . . . . Columbus, Ga. . . . Oct. 26, 1892.
Edward B. Townsend, . Treas. Warwick Mills, ... 27 Kilby St., Boston, Mass. . . . Apr. 25, 1901.
D. Irving Trainer . . . Agt. Lincoln Mfg. Co. . . . . Chester, Pa. . . . . Apr. 23, 1903.
Robert B. Treat . . . . Pres. and Treas. Mannfacturers Fuel Co. of Rhode Island . . . . . 1032 Banigan Bldg., Providence, R. I. . . Sept. 27, 1894.
C. H. Truesdell . . . . Supt. Attawaugan Co. . . . . Killingly, Conn. . . Oct. 29, 1884.
Edmund E. Truesdell . Supt. China, Webster & Pembroke Mills . . . . . Suncook, N. H. . . . Apr. 26, 1876.
Oscar B. Truesdell . . . . . 18 Washington Terrace, Newtonville, Mass. . Oct. 15, 1873.
George E. Tucker . . . Agt. Otis Co. . . . . Ware, Mass. . . . . Oct. 25, 1895.
Philip S. Tuley . . . Pres. and Treas. Louisville Cotton Mills Co. . . . . 1008 Goss Ave., Louisville, Ky. . . . Oct. 18, 1900.
George W. Turner . . Supt. Argo Mills Co. . . . . Gloucester City, N. J. Apr. 26, 1900.
William D. Twiss . . . Supt. Everett Mills . . . . . Lawrence, Mass. . . April 29, 1896.

Fenwick Umpleby . . Instr. Lowell Textile School . . . . Lowell, Mass. . . . . Apr. 27, 1905.
Charles T. Upton . . . . . 63 Mt. Vernon St., Lowell, Mass. . . . Apr. 28, 1897.

George A. Vaughan . . Supt. The Putnam Manufg. Co. . . Putnam, Conn. . . . Sept. 22, 1896.
William P. Vaughan . Agt. Putnam Manufacturing Co. . . . . 1041 Banigan Building, Providence, R. I. . . Sept. 29, 1898.
Frank P. Vogl . . . . Agt. Monadnock Mills . . . . . Claremont, N. H. . . Sept. 27, 1894.

Jude C. Wadleigh . . . Agt. Merrimack Mfg. Co. . . . . Lowell, Mass. . . . Oct. 26, 1892.
Herbert E. Walmsley . Agt. Wamsutta Mills . . . . . New Bedford, Mass. . Oct. 29, 1890.
Robinson Walmsley . . Supt. Tecumseh Mills, P. O. Box 246, Fall River, Mass. . . Apr. 27, 1899.
Frederick T. Walsh . . Mgr. Thomas Leyland & Co., Dyestuffs, etc. . . . . 195 Nesmith St., Lowell, Mass. . . . Apr. 28, 1897.
Frederick E. Waterman Treas. Stafford Mills & Cornell Mills, Fall River, Mass. . . Sept. 22, 1904.
Joseph Watters . . . . Supt. Osborn Mills . . . . . Fall River, Mass. . . Oct. 15, 1873.
F. E. Wattles . . . . Agt. Boscawen Mills . . . . . Penacook, N. H. . . Oct. 5, 1899.
Wm. T. Westerman . . Mgr. Ontario Spinning Co. . . . . 1729 Philip St., Philadelphia, Pa. . . Oct. 1, 1903.
W. B. Smith Whaley . Mechanical & Mill Engineer, Pres. Richland Cotton Mills, ... Granby Cotton Mills, 1012 Tremont Bldg., Boston, Mass, ... 1328 Main St., Columbia, S. C. . . Apr. 24, 1895.
Channing Whitaker . . Infringement and Patentability of Inventions . . . . . Lowell Machine Shop . . . . . Lowell, Mass. . . . Oct. 15, 1873.
A. Tenny White . . . Supt. Manville Co. . . . . Manville, R. I. . . . Oct. 27, 1887.
Alphonso F. White . . Supt. Forestdale Mfg. Co., ... Forestdale, R. I. . . Apr. 24, 1902.
Arthur F. Whitin . . . Pres. Saunders Cotton Mills . . . . Whitinsville, Mass. . Apr. 24, 1895.

Fred B. Whitin	Agt. Uxbridge Cotton Mills	Linwood, Mass.	Apr. 28, 1897.
Henry T. Whitin	Treas. Paul Whitin Manufg. Co.	Northbridge, Mass.	Apr. 25, 1877.
James Earle Whitin	Pres. Uxbridge Cotton Mills	Whitinsville, Mass	Apr. 23, 1903.
Paul Whitin	Asst. Treas. Paul Whitin Mfg. Co.	Northbridge, Mass.	Oct. 1, 1903.
William Whitman	Pres. Arlington Mills, 78 Chauncy St. P. O. Box 100, Essex St. Station,	Boston, Mass.	Apr. 25, 1901.
William S. Whitney	Supervising Engineer, American Woolen Co.	Lawrence, Mass.	Apr. 24, 1878.
Arthur Whittam	Pres. and Mgr. John M. Stone Cotton Mills	Starkville, Miss.,	Apr. 27, 1898.
George F. Whitten	Agt. Amory Mfg. Co.	Manchester, N. H.	Oct. 26, 1892.
John H. Whitten	Agt. Stark Mills	Manchester, N. H.	Apr. 27, 1898.
W. R. B. Whittier	Mgr. Whittier Mills	Chattahoochee, Fulton Co., Ga.	Oct. 18, 1900.
George A. Wies	Treas. Eureka Fire Hose Co.	13 Barclay St., New York City	Apr. 24, 1902.
R. W. Wight,	Asst. Treas. Indian Orchard Co.,	Indian Orchard, Mass.,	Apr. 28, 1904.
Edward B. Wilbur	Gen. Mgr. & Supt. Mollohon Mfg. Co.	Newberry, S. C.	Oct. 30, 1889.
Benjamin Wilcox	Treas. City Mfg. Co.	New Bedford, Mass.	Apr. 26, 1900.
John B. Wild	Pres. Oneita Knitting Mills	Utica, N. Y.	Apr. 26, 1900.
Eben C. Willey	Mgr. Hope Mills Mfg. Co.	Hope Mills, N. C.	Apr. 29, 1896.
Franklin D. Williams	Asst. Treas. Hamilton Mfg. Co.	70 Kilby St. Room 48 Boston, Mass.	Apr. 25, 1901.
Henry Williams	Supt. Canoe River Mill	Taunton, Mass.	Apr. 23, 1903.
Broadus E. Willingham,	Sec. and Treas. Willingham Cotton Mills	Macon, Ga.	Oct. 18, 1900.
Elias S. Willis	Supt. Boott Cotton Mills	Lowell, Mass.	Apr. 23, 1903.
William E. Winchester	Director Mississippi Textile School,	Agricultural College, Miss.	Apr. 24, 1902.
Samuel F. Winsper	Supt. City Mfg. Co.	New Bedford, Mass.	Apr. 23, 1903.
George Wood	Pres. and Treas. Millville Manufg. Co.	626 Chestnut St., Philadelphia, Pa.	Oct. 16, 1872.
John P. Wood		521 N. 22d St., Philadelphia, Pa.	Apr. 28, 1897.
Oscar W. Wood	Treas. Germantown Spinning Co.	Germantown, Philadelphia, Pa.	Oct. 18, 1900.
Wm. I. Woodward	Agt. Shetucket Co.,	Norwich, Conn.	Apr. 23, 1903.
Frank F. Wooley	Supt. Coventry Co.	Anthony, R. I.	Apr. 27, 1905.
Adelbert R. Young	Supt. Ashland Cotton Co.	Jewett City, Conn.	Apr. 25, 1894.
James M. Young	Mgr. Hamilton Cotton Co.	Hamilton, Ont., Can.	Apr. 27, 1899.
Lewis J. Young	Supt. Gault Mills of Montreal Cotton Co.	Lock Box 240, Valleyfield, P. Q., Canada	Oct. 1, 1903.

ASSOCIATE MEMBERS.

Eugene C. Andres . . Exporter and Importer . . . . . 517 John Hancock Building, Boston, Mass. . . . . Oct. 18, 1900.

Henry B. Ashton . . . Agt. S. A. Felton & Son Co. . . . . Manet Road, Chestnut Hill, Mass. Apr. 26, 1900.

Henry Ashworth . . . Agt. of Elijah Ashworth, Mfr. of Card Clothing . . . . . 89 Globe Mills Ave., Box 427, Fall River, Mass. . . Apr. 28, 1897.

George R. Babbitt . . . Pres. and Gen. Mgr. American Oil Co. and Pres. and Treas. . . . . The Burke Eng. Co., 182 So. Water St., Providence, R. I. . Apr. 24,1895.

D. C. Ball . . . . . 5 Beekman St., New York, N. Y. . . Oct. 25, 1895.

Edwin Barnes . . . . Vice Pres. Wm. Firth Co. . . . . 67 Equitable Building, Boston, Mass. . . . . Apr. 26, 1900.

George S. Barnum . . Sec. and Treas. The Bigelow Co. . New Haven, Conn. . Apr. 24, 1895.

Colin C. Bell . . . . Vice-Pres. American Vulcanized Fibre Co. . . . . 12 Pearl St., Boston, Mass. . . . Apr. 29, 1896.

Frank P. Bennett . . . Publisher American Wool and Cotton Reporter . . . . . 530 Atlantic Ave., Boston, Mass. . . . Sept. 22, 1896.

William H. Bent . . . Treas. Mason Machine Works . . . Taunton, Mass. . . . April 29, 1896.

Edward H. Best . . . Woolen Merchant, 224 Purchase St., Boston, Mass. . . Apr. 23, 1903.

Albert Birch . . . . . Birch Bros. Co. . . . . Somerville, Mass. . . . Oct. 2, 1902.

F. H. Bishop . . . . . Gen. Mgr. Universal Winding Co. . . . . 95 South St., Boston, Mass. . . . . Apr. 26, 1900.

Edmund E. Blake . . Selling Agt. Saco & Pettee Machine Shops Biddeford, Me. . Oct. 2, 1902.

Arthur T. Bradlee, . . Mem. firm of Harding, Whitman & Co. . . . . 78 Chauncy St., Boston, Mass. . . . . Apr. 25, 1901.

J. Payson Bradley . . . The Kehew Bradley Co. . . . . 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.

J. Frank Braids . . . . Mgr. Grease & Oil Dept., Charles S. Bush Co. . . . . Box 20, 212 Weybosset St., Providence, R. I. . . Apr. 28, 1897.

Samuel N. Braman . . Engineer Westinghouse Machine Co. . . . . 131 State St., Boston, Mass. . . . Apr. 27, 1905.

Henry Gordon Brinckerhoff, N. E. Mgr. Green Fuel Economizer Co., ... Room 1053, Exchange Bldg., 53 State St., Boston, Mass. Sept. 22, 1896.

H. Martin Brown . . . Treas. U. S. Bobbin & Shuttle Co. . Providence, R. I. . . Apr. 24, 1895.

George L. Brownell . . Inventor and Builder of Improved Twisting Machinery . . . . . 49 Union St., Station A, Worcester, Mass. . . Apr. 23, 1903.

Percy H. Brundage . . . . . 49 Wall St., New York, N. Y. . . Oct. 5, 1899.

John H. Burghardt . . Page Belting Co. . . . 31 Pearl St., Boston, Mass. . . . Apr. 24, 1895.

Charles B. Burleigh . . Textile Power Dept., General Electric Co. . . . . 84 State St., Boston, Mass. . . Oct. 1, 1903.

Eugene E. Burnham . . Belt Mfr. . . . . 252 Lowell St., Lawrence, Mass. . . Oct. 25, 1895.

Arthur Cecil Butler, . . Agt. for E. A. Leigh, ... 232 Summer St. Boston, Mass.Apr. 28, 1904.

Harry W. Butterworth . Sec. H. W. Butterworth & Sons . . . . . York and Cedar Sts., Philadelphia, Pa. . . Oct. 28, 1897.
James Butterworth . Pres. H. W. Butterworth & Sons . . . . . York and Cedar Sts., Philadelphia, Pa. . . Apr. 24, 1895.

L. W. Campbell, . . . Agt. Woonsocket Machine and Press Co. . . . . Woonsocket, R. I. . . Sept. 22, 1904.
Malcolm Campbell . . Gen. Mgr. Woonsocket Machine and Press Co. . . . . Woonsocket, R. I. . . Apr. 24, 1895.
W. W. Carey . . . . . Mfr. Wood Rim Pulleys and Wood Working Machinery . . . . . 514 Broadway, Lowell, Mass. . . . . Apr. 24, 1895.
Albert C. Case . . . . . 25 Broad St., Room 1213, New York, N. Y. . . Sept. 26, 1901.
J. E. Cheesman . . . . Pres. Cheesman Cotton Gin Co. . . . . 76 William St., New York, N. Y. . . Oct. 5, 1899.
Charles H. Child . . . Treas. Standard Mill Supply Co. . . . . P. O. Box 1426, 39 Exchange Place, Providence, R. I. . . Apr. 24, 1895.
Melvin H. Coffin . . . Selling Agt. Whitin Machine Works Whitinsville, Mass. . Oct. 2, 1902.
Howard D. Colman . . Pres. and Treas. Barber-Coleman Co. Rockford, Ill. . . . . Apr. 27, 1905.
C. C. Cowan . . . . . 27 William St., New York, N. Y. . . Oct. 5, 1899.
Thomas G. Cox . . . . Selling Agt. Mason Machine Works . . . . . Box 316, Taunton, Mass. . . . Apr. 24, 1895.
Randolph Crompton . . Mem. firm of Crompton-ThayerLoom Co. . . . . Worcester, Mass. . . Oct. 28, 1897.
C. F. Curwen . . . . Treas. Dinsmore Mfg. Co. . . . . Salem, Mass. . . . . Apr. 27, 1899.
Joseph L. Cushing . . Mfr. of Cotton Conveying Systems, Daniel Cushing & Co., ... Box 885, Lowell, Mass. . . . . Apr. 26, 1900.

Frederick I. Dana . . . Gen. Sales Mgr., The Textile Machinery Finishing Co. . . . . Providence, R. I. . . Apr. 24, 1895.
Daniel J. Danker, . . . Mem firm of Danker & Marston, Importers of dyestuffs and . . . . . chemicals . . 247 Atlantic Ave., Boston, Mass. . . . Apr. 28, 1904.
Charles Henry Davis . C. E., Charles Henry Davis & Partners, ... 25 Broad St., New York, N. Y. . . Apr. 23, 1903.
Hugh De Haven . . Prop. De Haven Mfg. Co. . . . . 50-54 Columbia Heights, Brooklyn, N. Y. . . Apr. 23, 1903.
John O. DeWolf, . . . Mech. Engineer W. B. Smith Whaley & Co. . . . . 1012 Tremont Bldg., Boston, Mass. . . . Apr. 25, 1901.
Frederick N. Dillon . . D. M. Dillon Steam Boiler Works . Fitchburg, Mass. . . Sept. 22, 1904.
C. E. W. Dow . . . . Selling Agt. American Moistening Co. . . . . 150 Devonshire St., Boston, Mass. . . . Apr. 24, 1895.
Frederick A. Downes . Pres. Keystone Mutual Fire Insurance Co. . . . . 925 Chestnut St., Philadelphia, Pa. . . Oct. 28, 1897.
W. L. Draper . . . . Mgr. Dodge Mfg. Co. . . . . Atlanta Branch, 507 Prudential Building, Atlanta, Ga. . . . . Oct. 18, 1900.

Charles E. Eager . . . Member firm J. Russel Marble & Co. . . . . 124 High St., Boston, Mass. . . . Apr. 27, 1905.
Fred W. Easton, . . . Treas. Easton & Burnham Machine Co., ... 180 Weeden St., Pawtucket, R. I. . . Apr. 25, 1901.
William Dresser Edwards Cons. Eng. Randolph Bldg. . . . . Memphis, Tenn. . . . Oct. 2, 1902.
G. B. Emmons . . . . Pres. Emmons Loom Harness Co. . . . . May St., Lawrence, Mass. . . Oct. 25, 1895.
George P. Erhard . . . Vice-Pres. The Geo. W. Stafford Co. Readville, Mass. . . . Apr. 27, 1905.

D. D. Felton . . . . . Treas. S. A. Felton & Son Co. . . . Manchester, N. H. . Apr. 24, 1895.
John W. Ferguson . . Contractor . . . . . Paterson Nat. Bank Bldg., Paterson, N. J. . . . Apr. 24, 1895.
L. L. Flemming . . . Vice-Pres. and Gen. Mgr. American Cotton Co. . . . . 25 Broad St., Lock Box 240, New York, N. Y. . . Apr. 23, 1903.
E. C. Foerster . . . . Mfr. Textile Machinery . . . . . 415 Broadway New York, N. Y. . . Sept. 22, 1904.
J. Herbert Foster . . . Cotton Broker . 10 South Water St., Providence, R. I. . . Apr. 24, 1895.
John T. Fyans . . . . Agt. Fyans, Frazer & Blackway Co. . . . . 411 Beach St., Fall River, Mass. . . Apr. 28, 1897.
H. P. Garland . . . . Treas. Garland Mfg. Co. . . . . Saco, Me. . . . . Oct. 25, 1895.
Royal W. Gates . . . . Josiah Gates & Sons, Belting . . . . . 367 Market St., Lowell, Mass. . . . Apr. 24, 1895.
Vladimir F. Gnesin . . Care, The Great Yaroslavl Mfg. Co. Moscow, Russia . . . . Oct. 1, 1903.
Rufus B. Goff . . . . Pres. Standard Mill Supply Co. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . Apr. 28, 1897.
Arthur F. Gray . . . . Architect and Mill Engineer . . . . . 53 State St., Room 509, Boston, Mass. . . . Oct. 18, 1900.
Samuel M. Green, M. E. The American Thread Co. . . . . Holyoke, Mass. . . . Apr. 24, 1902.
S. Harold Greene . . . Starch Manufacturer . . 367 Atlantic Ave. Boston, Mass. . Apr. 27, 1905.
Allen B. Greenough . . Harrison Yarn and Bleaching Co. . Taunton, Mass. . . . Apr. 27, 1905.

A. Walter Harris . . . Treas. A. W. Harris Oil Co. . . . . Box 758, 326 So. Water St., Providence, R. I. . . Oct. 25, 1895.
Alfred H. Hartley . . Dealer in Oils and Mill Supplies . . . . . Box 409, Fall River, Mass. . . Oct. 28, 1897.
Edward F. Hathaway . Gen. Mgr., American Warp Drawing Machines . . . . . 289 A St., Boston, Mass. . . . Apr. 27, 1905.
Charles C. Hedrick . . Mech. Eng. Lowell Machine Shop . Lowell, Mass. . . . Apr. 23, 1903.
Jerome Hill . . . . . Pres. Jerome Hill Cotton Co. . . . . 334 Front St., Memphis, Tenn. . . . Apr. 29, 1896.
Richard H. Hill . . . Gen. Sales Agt. James Hunter Machine Co. . . . . 70 Kilby St., Boston, Mass. . . . . Apr. 26, 1900.
John Hogg . . . . . Smith, Hogg & Gardiner, 144 Essex St., Boston, Mass. . . . Apr. 27, 1899.
Henry A. Holcomb . . . . . Box 249, New Bedford, Mass. . Oct. 25, 1895.

Henry S. Houghton, Sr., Mfr. Grids and Beaters, 61 Pond St., Woonsocket, R. I. . Apr. 28, 1897.
Lewis T. Houghton . . Mfr. Appliances for Cotton Machinery . . . . . .
. . . . . 997 Main St., Worcester, Mass. . . Sept. 26, 1901.
A. H. Howard . . . . Pres. and Treas. Howard Bros. Mfg. Co. . . . . .
. . . . . P. O. Box 54, Worcester, Mass. . . Sept. 26, 1901.
Frederic W. Howe . . Salesman Crompton & Knowles Loom Works . . . . . .
. . . . . 241 Harris Ave., Box 899, Providence, R. I. . . Apr. 24, 1902.
C. H. Hutchins . . . . Pres. Crompton & Knowles Loom Works . . . . . .
. . . . . Worcester, Mass. . . Oct. 25, 1895.

Charles L. Ireson, . . . Belt Mfr. . . . . .
. . . . . P. O. Box 2052, 148 High St., Boston, Mass. . . . . Apr. 28, 1904.

Daniel Jackson . . . . Cotton Buyer B. B. and R. Knight, . Providence, R. I. . . Apr. 24, 1902.
David Jackson . . . . Gen. Mgr. Jackson Pat. Shell Roll Co., Pawtucket, R. I. . . Apr. 24, 1895.

Lawrence M. Keeler . Whitin Machine Works . . . . . Whitinsville, Mass. . Sept. 26, 1901.
William B. Kehew . . The Kehew-Bradley Co., ...
. . . . . 24 Purchase St., Boston, Mass. . . . Apr. 24, 1895.
James H. Kendall . . Edward Kendall & Sons . . . . . Cambridgeport, Mass., Sept. 29, 1898.
John E. Kendrick . . . Pres. American Supply Co., Box 822, Providence, R. I. . . Oct. 5, 1899.
Frank B. Kenney . . . Mgr. Care of T. C. Entwistle Co. . . . . .
. . . . . 297 Market St., Lowell, Mass. . . . Oct. 5, 1899.
Joseph C. King . . . . Ring Traveler . . . 133 Essex St., Boston, Mass. . . . Oct. 1, 1903.

W. C. Langford . . . Salesman, . . . 86 Weybosset St., Providence, R. I. . . Apr. 27, 1899.
Josiah M. Lasell . . . Whitin Machine Works, ... Whitinsville, Mass. . Apr. 24, 1895.
John H. Lawrence . . Top Roll Mfr. . . . . New Bedford, Mass. . Apr. 28, 1904.
Frank A. LeValley . . Cotton Broker . . . . . Fall River, Mass. . . Apr. 28, 1904.
John H. Lorimer . . . Builder of Textile Machines . . . . . .
. . . . . Ontario and Lawrence Sts., Philadelphia, Pa. . . Oct. 28, 1897.
Sanford E. Loring . . Con. Architect, 341 Delaware St., . Syracuse, N. Y. . . Apr. 24, 1902.
Stephen C. Lowe . . . Agt. John Hetherington & Sons, Ltd., ...
. . . . . 186 Devonshire St., Boston, Mass. . . . Oct. 25, 1895.
Francis E. Macomber . Mill Supplies . . . . 21 Pearl St., Boston, Mass. . . . . Apr. 26, 1900.
D. Edgar Manson . . . Agt. Westinghouse Elec. & Mfg. Co. P. O. Box 3483 . . .
. . . . . 131 State St., Room 716, Boston, Mass. . . . Apr. 28, 1904.
John B. Marston . . . Mem. of firm Danker & Marston . . . . . .
. . . . . 247 Atlantic Ave., Boston, Mass. . . . . Apr. 28, 1904.
Fay H. Martin . . . . Pres. Textile Machinery Co. . . . . .
. . . . . 50 State St., Boston, Mass. . . . . Sept. 26, 1901.
Henry W. Mason . . . Cotton Dealer, . 10 South Water St., Providence, R. I. . . Apr. 27, 1905.

F. H. Maynard . . . . Gen. Bus. Mgr. Gen. Fire Extinguisher Co. . . . . Providence, R. I. . . . Apr. 24, 1895.
John McCullough, . . . Cotton Waste Merchant . . . . . New Bedford, Mass. . April 25, 1901.
H. G. McKerrow . . . Textile Machinery Importer . . . . . 31 State St., Boston, Mass. . . . Sept. 22, 1896.
D. K. McLaren . . . . Mfr. of Leather Belting 751 Craig St., Montreal, P. Q., Can. Apr. 26, 1900.
Meldon H. Merrill . . Eng. Westinghouse Elec. & Mfg. Co., ... 716 Board of Trade Bldg. Boston, Mass. . . . . Sept. 22, 1904.
Charles B. Moore . . . Mgr. Knowles Steam Pump Works . . . . . 54 Oliver St., Boston, Mass. . . . . Apr. 26, 1900.
S. F. B. Morse . . . . Pres. Southern Cotton Corporation . . . . . 74 Broadway, New York, . . N. Y. Sept. 22, 1904.

John H. Nelson . . . . Treas. William Firth Co. . . . . 60 Baltimore St., Lynn, Mass. . . . . Apr. 26, 1900.
William R. Noone . . . . . 102 South St., Boston, Mass. . . . Oct. 28, 1897.

Thos. J. O'Keefe . . . Mgr. Charles L. Ireson . . . . . 148 High St., Boston, Mass. . . . . Apr. 28, 1904.

Sidney B. Paine . . . General Electric Co. . . 84 State St., Boston, Mass. . . . Apr. 24, 1895.
William F. Parish, Jr. . Chief, Vacuum Oil Co. (Technical Department) . . . . . 49 Deansgate, Manchester, England, Apr. 24, 1902.
Arthur Parkinson . . . Selling Agt. Arabol Mfg. Co. . . . . 100 William St., New York, N. Y. . . Apr. 28, 1897.
John Parmenides . . . Choremi, Benachi & Co. 50 Congress St. . . . . Boston, Mass. . . . . Apr. 27, 1905.
Stephen Minot Pitman . Sec'y Narragansett Mutual Fire Insurance Co. . . . . 721 Banigan Bldg., Box 315, Providence, R. I. . . Apr. 24, 1895.
Vladimir P. Polevoy . . . . . 120 Broadway, N. Y. Apr. 28, 1897.
Charles F. Pray . . . . Cloth Broker . . . 72 Leonard St., New York, N. Y. . . Apr. 28, 1904.
Charles A. M. Praray . Chas. A. M. Praray & Co., Architect and Mill Engineer . . . . . 48 Weybosset St., Providence, R. I. . . Apr. 28, 1897.
Theodore H. Price . . Cotton Dealer . . . 82 Beaver St., New York, N. Y. . . Oct. 2, 1902.
Frank W. Reynolds . . Mem. firm Lockwood Greene & Co. . . . . 93 Federal St., Boston, Mass. . . . Apr. 28, 1904.
Peleg A. Rhodes . . . Sec. Cotton Mill Mutual Fire Insurance Co. . . . . Augusta, Ga. . . . . Oct. 5, 1899.
Richard H. Rice . . . Gen. Elec. Co. . . . . Lynn, Mass. . . . . Apr. 24, 1895.
E. R. Richardson . . . Asst. Treas. Howard & Bullough American Machine Co., Ltd. . . . . Box 678, Pawtucket, R. I. . . Apr. 26, 1900.
C. E. Roberts . . . . Mgr. Hartford Steam Boiler Inspection & Insurance Co. . . . . 101 Milk St., Room 400, Boston, Mass. . . . Apr. 24, 1895.

J. L. Sanford . . . . Barber-Colman Co., 11 Pemberton Sq., Boston, Mass. . . . Apr. 27, 1905.
William B. Scofield . . Mem. firm of Crompton-Thayer Loom Co. . . . . Worcester, Mass. . . Apr. 28, 1904.
Dwight Seabury . . . Mill Engineer . . . 12 East Ave., Pawtucket, R. I. . . Apr. 25, 1901.
William N. Shaw . . . Treas. The Lincoln Iron Works and Jackson Architectural . . . . . Iron Works . . 31 E. 17th St., New York, N. Y. . . Apr. 24, 1902.
Lewis T. Shurtleff . . . Agt. Paper Department, Pairpont Corporation, ... New Bedford, Mass. Apr. 28, 1904.
Harry M. Smith . . . Vice-Pres. Standard Mill Supply Co. . . . . 77 Exchange Pl., Box 714, Providence, R. I. . . Apr. 28, 1897.
R. Paul Snelling . . . Treas. Saco and Pettee Machine Shops . . . . . Newton Upper Falls, Mass. . Sept. 22, 1896.
Henry C. Spence . . . Gen. Mgr. Metallic Drawing Roll Co. Indian Orchard, Mass. Apr. 24, 1895.
James Strang . . . . Selling Agt. Metallic Drawing Roll Co. . . . . 123 Hampden St., Indian Orchard, Mass. Oct. 28, 1897.
Daniel J. Sully . . . . Cotton Broker, T. M. Reynolds & Co., ... 34 South Water St., Providence, R. I. . . Apr. 24, 1895.
E. Kent Swift . . . . Whitin Machine Works, ... Whitinsville Mass. . . Apr. 27, 1905.
John Sykes, J. P. . . . Pres. English Card Clothing Co. . . . . Acre House, Huddersfield, Eng. . Oct. 18, 1900.

Cyrus A. Taft . . . . Agt. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.
Charles F. Taylor . . . Prop. Burgess Cop Tube Co., ... 15 Custom House St., Providence, R. I. . . Apr. 27, 1898.
Elwood E. Taylor . . . N. E. Mgr., Stoker Dept. Amer. Ship Windless Co. of Provi- . . . . . dence, R. I., 12 Humbolt Ave., Boston, Mass. . . . Apr. 23, 1903.
Robert Taylor, Jr. . . Mgr. Asa Lees & Co. Ltd. . . . . Oldham, England . . Apr. 28, 1904.
George C. Tewksbury . N. E. Mgr. The Under-Feed Stoker Co. of America . . . . . 141 Milk St., Boston, Mass. . . . Apr. 24, 1902.
James T. Thornton . . Treas. Thornton Machinery Co. . . Providence, R. I. . . Oct. 18, 1900.
William V. Threlfall . . Agt. Saco and Pettee Machine Shops, Biddeford, Me. . . . Apr. 24, 1895.
Rienzi Thurston, . . . Mach. Mfr. . . . . Fall River, Mass. . . Oct. 18, 1900.
H. A. Tillinghast, . . . Treas. The Textile Finishing Mach. Co. . . . . Providence, R. I. . . Apr. 25, 1901.
A. Curtis Tingley . . . Treas. National Ring Traveler Co. . . . . 257 West Exchange St., Providence, R. I. . . Sept. 22, 1896.
Allison W. Trafford . . Mfr. of Ring Travelers . . . . . 116 Pocasset St., Fall River, Mass. . . Apr. 26, 1900.

Frank H. Underwood . Resident Mgr. Dodge Mfg. Co. . . . . 137 Purchase St., Boston, Mass. . . . Apr. 29, 1896.

Clement A. Wakefield . Selling Agt. Saco & Pettee Machine Shops, ... 38 South St., Biddeford, Me. . . . Apr. 25, 1901.
Justin A. Ware . . . . . Spring Hill, Barnstable County, Mass. Oct. 25, 1895.

William Warr . . . . Engineer Robins' Conveying Belt Co., ... 53 State St., Boston, Mass. . . . . Apr. 27, 1905.
J. F. Warren . . . . . Treas. J. F. & W. H. Warren Co. . . . . 44 Vine St., Worcester, Mass. . . Apr. 24, 1902.
Lettice R. Washburn . Mill Contractor, 235 North Water St., New Bedford, Mass. . Oct. 5, 1899.
Walter S. Watson . . . Haworth & Watson, Mfrs. Paper Tubes for Textile Manufg. . . . . Box 996, Lowell, Mass. . . . . Oct. 25, 1895.
Sephen M. Weld, . . Stephen M. Weld & Co., 89 State St., Boston, Mass. . . . Apr. 27, 1899.
William R. West . . . Roll Coverer . . 830 Purchase St., New Bedford, Mass. . Sept. 22, 1896.
W. W. White . . . . Agent Holyoke Machine Co. . . . Worcester, Mass. . . Apr. 27, 1899.
G. Marston Whitin . . Treas. Whitin Machine Works . . . Whitinsville, Mass. . Apr. 24, 1895.
Fred A. Wilde . . . . Gen. Mgr. The A. T. Atherton Machine Co. . . . . Prairie Ave., Pawtucket, R. I. . . Apr. 28, 1897.
Erving Yale Woolley . Sel. Agt. Stoddard, Haserick, Richards & Co. . . . . 152 Congress St., Boston, Mass. . . . . Apr. 24, 1895.

Honorary Members	3
Life Members	7
Active Members	582
Associate Members	163
Total Membership	755

MEMBERS OF THE ASSOCIATION,

May 1, 1905.

ARRANGED BY STATES.

MAINE.

Auburn	William Hayes	Barker Mill.
Augusta	Albert S. Pratt	Edwards Mfg. Co.
Biddeford	Edmund E. Blake	Saco & Pettee Machine shops.
Biddeford	Robert McArthur	Pepperell Mfg. Co.
Biddeford	William V. Threlfall	Saco & Pettee Machine Shops.
Biddeford	Clement A. Wakefield	Saco & Pettee Machine Shops.
Brunswick	Russell W. Eaton	Cabot Manufg. Co.
Kennebunk	Robert W. Lord	R. W. Lord & Co.
Lewiston	George W. Bean	Androscoggin Mills.
Lewiston	H. B. Estes	Continental Mills.
Lewiston	William D. Pennell	Hill Manufg. Co.
Lewiston	Herbert L. Pratt	Bates Manufg. Co.
Lewiston	Henry Rowe	166 Holland St.
Portland	Lyman M. Cousens	Dana Warp Mills.
Saco	H. P. Garland	Garland Mfg. Co.
Saco	James G. Garland	Garland Mfg. Co.
Saco	Elmer E. Page	York Manufg. Co.
Westbrook	Philip Dana	Dana Warp Mills.
Westbrook	Woodbury K. Dana	Dana Warp Mills.

NEW HAMPSHIRE.

Charlestown	Samuel Webber	Hydraulic Engineer.
Claremont	Frank P. Vogl	Monadnock Mills.
Dover	Charles H. Fish	Cocheco Manufg. Co.
Dover	Herbert W. Owen	Cocheco Manufg. Co.
Exeter	Chester D. Hatch	Exeter Mfg. Co.

Exeter	Hervey Kent	Exeter Manufg. Co.
Greenville	Frederick W. Ely	Columbian Manufg. Co.
Hooksett	Stephen N. Bourne	Dundee Mills.
Manchester	Henry Deane Bourne	Hooksett Manufg. Co.
Manchester	D. D. Felton	S. A. Felton & Son Co.
Manchester	Elliott Cowdin Lambert	Amoskeag Manufg. Co.
Manchester	Charles H. Manning	Amoskeag Manufg. Co.
Manchester	Herman F. Straw	Amoskeag Manufg. Co. & Manchester Mills.
Manchester	George F. Whitten	Amory Manufg. Co.
Manchester	John H. Whitten	Stark Mills.
Milford	M. F. Foster	
Nashua	William F. Arthur	Nashua Manufacturing Co.
Nashua	William H. Cadwell	Jackson Co.
Nashua	Roscoe S. Milliken	Nashua Mfg. Co.
Newmarket	William H. Garner	Newmarket Mfg. Co.
Penacook	Marcellus Gould	N. H. Spinning Mills.
Penacook	F. E. Wattles	Boscawen Mills.
Peterboro	Albert W. Noone	Jos. Noone's Son's Co.
Pittsfield	William P. Adams	Pittsfield Mills.
Salmon Falls	J. Colby Lewis	Salmon Falls Mfg. Co.
Somersworth	Charles H. Plummer	Great Falls Manufg. Co.
Suncook	David L. Jewell	China, Webster & Pembroke Mills.
Suncook	Edmund E. Truesdell	China, Webster & Pembroke Mills.

VERMONT.

North Pownal	Thomas Armstrong	North Pownal Manufg. Co.

MASSACHUSETTS.

Adams	John S. Adams, Jr.	Adams Bros. Manufg. Co.
Adams	Z. D. Hall	Berkshire Cotton Manufg. Co.
Adams	Ernest L. Hill	Renfrew Mfg. Co.
Adams	Emil Kipper	Windsor Print Works.
Adams	William B. Orr	Renfrew Mfg Co.
Adams	Charles T. Plunkett	Berkshire Cotton Manufg. Co.
Adams	William C. Plunkett,	W. C. Plunkett & Sons.
Adams	J. N. Sanderson	Renfrew Mfg. Co.
Adams	Charles R. Thomson	Renfrew Mfg. Co.
Amesbury	M. W. Quinn	Hamilton Woolen Co.
Andover	John W. Bell	Smith & Dove Manufg. Co.
Blackstone	George E. Spofford	Blackstone Manufg. Co.
Bondsville	Elmer G. Childs	Boston Duck Co.
Bondsville	Samuel Stewart	Boston Duck Co.
Boston	Charles B. Amory	Hamilton Mfg. Co.
Boston	Frederic Amory	Nashua Mfg.Co. and Jackson Mfg.Co.

Boston	Eugene C. Andres	517 John Hancock Building.
Boston	Edward Atkinson	Boston Mfrs. Mut. Fire Ins. Co.
Boston	E. W. Atkinson	Stoddard, Haserick, Richards & Co.
Boston	Nathaniel F. Ayer	10 P. O. Square.
Boston	Edwin Barnes	Wm. Firth Co.
Boston	Colin C. Bell	American Vulcanized Fibre Co.
Boston	Albert Farewell Bemis	Jackson Fibre Co.
Boston	Frank P. Bennett	Am. Wool and Cotton Reporter.
Boston	Edward H. Best	Woolen Merchant.
Boston	F. H. Bishop	Universal Winding Co.
Boston	Arthur T. Bradlee	Harding, Whitman & Co.
Boston	J. Payson Bradley	The Kehew-Bradley Co.
Boston	Samuel N. Braman	Westinghouse Machine Co.
Boston	S. Parker Bremer	Monadnock Mills.
Boston	Henry Gordon Brinckerhoff	Green Fuel Economizer Co.
Boston	John H. Burghardt	Page Belting Co.
Boston	Charles B. Burleigh	General Electric Co.
Boston	Arthur Cecil Butler	232 Summer St.
Boston	Frank B. Comins	American Moistening Co.
Boston	Alphonse S. Covel	Tremont and Suffolk Mills.
Boston	Daniel J. Danker	Danker & Marston.
Boston	Augustus De Cort	Beacon Mfg. Co.
Boston	P. Y. DeNormandie	Pepperell Mfg. Co.
Boston	John O. DeWolf	W. B. Smith Whaley & Co.
Boston	C. E. W. Dow	150 Devonshire St.
Boston	Frederic C. Dumaine	Amory Mfg. Co.
Boston	Charles E. Eager	J. Russel Marble & Co.
Boston	William Firth	Am. Moist. Co. and Wm. Firth Co.
Boston	Frederick O. Flather	Boott Mills.
Boston	Alfred M. Goodale	Boston Mfg. Co.
Boston	Arthur F. Gray	53 State St., Room 509.
Boston	Edwin Farnham Greene	Lockwood, Greene & Co. and Dwight Mfg. Co.
Boston	S. Harold Greene	Starch Mfg.
Boston	Edward F. Hathaway	American Warp Drawing Machine Co
Boston	Richard H. Hill	Jas. Hunter Machine Co.
Boston	William H. Hill	Renfrew Mfg. Co.
Boston	Franklin W. Hobbs	Arlington Mills.
Boston	John Hogg	Smith, Hogg & Gardiner.
Boston	Henry S. Howe	Dry Goods Commission.
Boston	Charles W. Hubbard	Ludlow Mfg. Associates.
Boston	Otis L. Humphry	78 Chauncy St.
Boston	Charles L. Ireson	Belt Mfr.
Boston	William B. Kehew	The Kehew-Bradley Co.
Boston	Joseph C. King	Morley Button Mfg. Co.
Boston	Evan Arthur Leigh	232 Summer St.
Boston	William C. Lovering	Whittenton Mfg. Co.

Boston	Stephen C. Lowe	John Hetherington & Sons, Ltd.
Boston	Herbert Lyman	39 Beacon St.
Boston	Ronald T. Lyman	Boston Mfg. Co.
Boston	Francis E. Macomber	21 Pearl St.
Boston	Charles T. Main	Dean & Main.
Boston	D. Edgar Manson	Westinghouse Elec. & Mfg. Co.
Boston	John P. Marston	Danker & Marston.
Boston	Fay H. Martin	Textile Machinery Co.
Boston	Fred C. McDuffie	Everett Mills and York Mfg. Co.
Boston	H. G. McKerrow	31 State St.
Boston	Meldon H. Merrill	Westinghouse Elec. & Mfg. Co.
Boston	Charles B. Moore	Knowles Steam Pump Works.
Boston	George B. Morison	Ballou Yarn Co.
Boston	Robert W. Neff	Chemical Mfr.
Boston	William R. Noone	102 South St.
Boston	Thomas J. O'Keefe	148 High St.
Boston	John Parmenides	Choremi, Benachi & Co.
Boston	Sidney B. Paine	General Electric Co.
Boston	Benjamin Phipps	4 Winthrop Sq.
Boston	Henry Smith Pritchett, LL.D.	Mass. Institute of Technology.
Boston	Frank W. Reynolds	Lockwood Greene & Co.
Boston	Charles E. Riley	C. E. Riley & Co.
Boston	C. E. Roberts	Hartford Steam Boiler Insp. & Ins.Co
Boston	Arnold B. Sanford	Kennebec Spinning Mills.
Boston	J. S. Sanford	Barber-Colman Co.
Boston	J. Herbert Sawyer	93 Federal St.
Boston	George H. Shapley	Silver Lake Co.
Boston	William F. Sherman	294 Washington St.
Boston	John Sullivan	C. E. Riley & Co.
Boston	Elwood E. Taylor	Amer. Ship Windlass Co.
Boston	George C. Tewksbury	The Under-Feed Stoker Co. of America.
Boston	James P. Tolman	Samson Cordage Works.
Boston	Edward B. Townsend	Warwick Mills.
Boston	Frank H. Underwood	Dodge Mfg. Co.
Boston	William Warr	Robins' Conveying Belt Co.
Boston	Stephen M. Weld	89 State St.
Boston	William Whitman	Arlington Mills.
Boston	Franklin D. Williams	Hamilton Mfg. Co.
Boston	Erving Yale Woolley	Stoddard Haserick, Richards & Co.
Cambridgeport	James H. Kendall	Edward Kendall & Sons.
Chicopee	O. D. Drew	Dwight Mfg. Co.
Chicopee Falls	M. A. Rawlinson	Chicopee Mfg. Co.
Clinton	William G. McLoon	Lancaster Mills.
Clinton	Charles H. Richardson	Lancaster Mills.
Clinton	George P. Taylor	286 Chestnut St.
East Cambridge	Ivers S. Adams	American Net and Twine Co.

East Dedham	Benjamin M. Earl	Merchant Dye Works.
Easthampton	George A. Ayer	West Boylston Co.
Fall River	F. S. Akin	Cornell Mills.
Fall River	Henry Ashworth	Agt. for Card Clothing Manufr.
Fall River	J. W. Bailey	Principal, The Bradford Durfee Textile School.
Fall River	John P. Bodge	Arkwright Mills.
Fall River	Jefferson Borden, Jr.	Fall River Bleachery Co.
Fall River	Nathaniel B. Borden	Barnard Manufg. Co.
Fall River	Richard B. Borden	Richard Borden Mfg. Co.
Fall River	James T. Broadbent	Bradford Durfee Textile School.
Fall River	Isaac A. Brown	Narragansett Mills.
Fall River	John L. Burton	1042 Plymouth Ave.
Fall River	Simeon B. Chase	King Philip Mills.
Fall River	John A. Collins	American Linen Co.
Fall River	Bradford D. Davol	Barnard Manufg. Co.
Fall River	Frank H. Dwelly	Tecumseh Mills.
Fall River	David H. Dyer	D. H. Dyer & Son.
Fall River	John H. Estes	Cotton Manufacturer.
Fall River	William Evans	Bourse Mills.
Fall River	Charles F. Farrar	49 Coggeshall St.
Fall River	John T. Fyans	Fyans, Frazer & Blackway Co.
Fall River	Arthur M. Hamilton	Hargraves and Parker Mills.
Fall River	John F. Hamlet	P. O. Box 160
Fall River	Alfred H. Hartley	Oils and Mill Supplies.
Fall River	William Hathaway	Barnard Mfg. Co.
Fall River	William B. Hawes	Yarn Broker.
Fall River	George H. Hills	Davol Mills and Stevens Mfg. Co.
Fall River	John H. Holt	Luther Mfg Co.
Fall River	William P. Holt	Barnaby Mills.
Fall River	Leonard Johnson	Wampanoag Mills.
Fall River	John Kniveton	Bradford Durfee Textile School.
Fall River	Frank A. Le Valley	Cotton Broker.
Fall River	Leontine Lincoln	Seaconnet Mills.
Fall River	Charles B. Luther	Luther Mfg. Co.
Fall River	Alexander Makepeace	Richard Borden Mfg. Co.
Fall River	Arthur H. Mason	Davis Mills.
Fall River	Philip A. Mathewson	King Philip Mills.
Fall River	Thomas McAuliffe	Stevens Manufg. Co.
Fall River	James A. McLane	Davis Mills.
Fall River	J. Edward Osborn	American Linen Co.
Fall River	Joseph H. Potter, Jr.	Durfee Mills.
Fall River	John Bion Richards	Davis Mills.
Fall River	Harry J. Ricketson	Merchants' Mfg. Co.
Fall River	Benj. H. Roberts	163 Grove St.
Fall River	Charles M. Shove	Granite Mills.
Fall River	W. Frank Shove	Pocassett Mfg. Co.

Fall River	Abbott E. Slade	Laurel Lake Mills.
Fall River	J. C. Smith	Chace Mills.
Fall River	Timothy Sullivan	Stafford Mills.
Fall River	Richard Thackeray	Weetamoe Mills.
Fall River	James O. Thompson, Jr.	Wampanoag Mills.
Fall River	Rienzi Thurston	Mach. Mfr.
Fall River	M. J. Toohey	Mfr. Rope, Twine and Banding.
Fall River	Allison W. Trafford	Mfr. Ring Travelers.
Fall River	Robinson Walmsley	Tecumseh Mills.
Fall River	Frederick E. Waterman	Stafford and Cornell Mills.
Fall River	Joseph Watters	Osborn Mills.
Fisherville	Albert W. Dimick	Fisher Mfg. Co.
Fisherville	Charles W. Fisher	Fisher Mfg. Co.
Fiskdale	John Gregson	Fiskdale Mills.
Fitchburg	Frederick N. Dillon	D. M. Dillon Steam Boiler Works.
Fitchburg	James C. Eteson	Orswell Mills.
Fitchburg	Ernest L. Hersom	Nockege Mill.
Fitchburg	George P. Grant, Jr.	Grant Yarn Co.
Fitchburg	W. E. Keach	Grant Yarn Co.
Fitchburg	Arthur H. Lowe	Parkhill Manufg Co.
Fitchburg	David Lowe	Parkhill Manufg. Co.
Fitchburg	Thomas C. Sheldon	Fitchburg Duck Mills.
Fitchburg	Walter F. Stiles	Orswell Mills.
Fitchburg	Ralph E. Thomson	Parkhill Manufg. Co., Mill C.
Holyoke	Samuel M. Green	The American Thread Co.
Holyoke	Alexander King, Jr.	American Thread Co.
Holyoke	Ernest Lovering	Lyman Mills.
Hopedale	Eben S. Draper	Draper Co.
Hopedale	George A. Draper	Draper Co.
Hopedale	George Otis Draper	Draper Co.
Hopedale	William F. Draper	Draper Co.
Hopedale	Frank J. Dutcher	Draper Co.
Housatonic	Jno. H. C. Church	Monument Mills.
Housatonic	Theodore Ellis Ramsdell	Monument Mills.
Hyde Park	Calvin H. Lee	Readville Cotton Mills.
Indian Orchard	William C. Godfrey	Indian Orchard Co.
Indian Orchard	Henry C. Spence	Metallic Drawing Roll Co.
Indian Orchard	James Strang	Metallic Drawing Roll Co.
Indian Orchard	R. W. Wight	Indian Orchard Co.
Lawrence	James W. Ahmuty	Atlantic Cotton Mills.
Lawrence	William A. Barrell	Lawrence Duck Co.
Lawrence	Joseph P. Battles	Joseph Battles Co.
Lawrence	Albert W. Brainard	Box 33.
Lawrence	Eugene E. Burnham	252 Lowell St.
Lawrence	G. B. Emmons	Emmons Loom Harness Co.
Lawrence	William D. Hartshorne	Arlington Mills.
Lawrence	Walter M. Hastings	Arlington Mills.

Lawrence	John T. Lord	Pacific Mills.
Lawrence	James I. Milliken	Everett Mills.
Lawrence	Walter E. Parker	Pacific Mills.
Lawrence	Robert Redford	Box 28.
Lawrence	Francis H. Silsbee	Pacific Mills.
Lawrence	Walter H. Summersby	Atlantic Cotton Mills.
Lawrence	William D. Twiss	Everett Mills.
Lawrence	William S. Whitney	American Woolen Co.
Leicester	Charles A. Denny	
Linwood	Amos G. Maddox	Linwood Mill.
Linwood	Fred B. Whitin	
Lowell	George E. Ames	Lawrence Manufg. Co.
Lowell	Frank A. Bowen	Appleton Co.
Lowell	Edward N. Burke	Lowell Machine Shop.
Lowell	W. W. Carey	Wood Rim Pulleys and Wood Working Machinery.
Lowell	Alfred M. Chadwick	Tremont and Suffolk Mills.
Lowell	Clarence N. Childs	Hamilton Mfg. Co.
Lowell	Avery B. Clark	Merrimack Mfg. Co.
Lowell	Daniel Clark	16 Fifth Ave.
Lowell	John J. Connell	Tremont and Suffolk Mills.
Lowell	A. G. Cumnock	Appleton Co.
Lowell	Joseph L. Cushing	Daniel Cushing & Co.
Lowell	Albert W. Danforth	Shanghai Cotton Cloth Mills.
Lowell	Edward P. Dennis	
Lowell	John H. Dunn	Tremont & Suffolk Mills.
Lowell	William Ambrose Eastman	Hooper Knitting Co.
Lowell	George Fish	Massachusetts Cotton Mills.
Lowell	Royal W. Gates	Josiah Gates & Sons.
Lowell	William E. Hall	Shaw Stocking Co.
Lowell	Charles C. Hedrick	Lowell Machine Shop.
Lowell	Arthur N. Hersom	221 Foster St.
Lowell	A. W. Hunking,	374 Stevens St.
Lowell	Frank B. Kenney	T. C. Entwistle Co.
Lowell	Charles F. Libby	Shaw Stocking Co.
Lowell	Alvin S. Lyon	Bigelow Co.
Lowell	Albert H. Morton	Kitson Machine Co.
Lowell	Oliver H. Moulton	Hamilton Manufg. Co.
Lowell	Will Nelson	Lowell Textile School.
Lowell	Franklin Nourse	Lawrence Manufg. Co.
Lowell	John W. Pead	305 Andover St.
Lowell	Haven C. Perham	Kitson Machine Co.
Lowell	John J. Rooney	Tremont & Suffolk Mills.
Lowell	Stephen E. Smith	Lowell Textile School.
Lowell	William S. Southworth	Mass. Cotton Mills.
Lowell	Berton A. Thissell	Boott Cotton Mills.
Lowell	Earl A. Thissell	Lowell Hosiery Co.

Lowell	Ariel C. Thomas	Boott Cotton Mills.
Lowell	Charles T. Upton	63 Mt. Vernon St.
Lowell	Fenwick Umpleby	Lowell Textile School.
Lowell	Jude C. Wadleigh	Merrimack Mfg. Co.
Lowell	Frederick T. Walsh	Thomas Leyland & Co.
Lowell	Walter S. Watson	Haworth & Watson.
Lowell	Channing Whitaker	Lowell Machine Shop.
Lowell	Elias S. Willis	Boott Cotton Mills.
Lynn	John H. Nelson	Wm. Firth Co.
Lynn	Richard H. Rice	Gen. Elec. Co.
Lynn	Henry B. Sprague	Boston Woven Hose and Rubber Co.
Lynn	C. J. H. Woodbury	51 Baltimore St.
Manchaug	T. B. Stevenson	Manchaug Co.
Methuen	Lewis E. Barnes	Pemberton Co. and Methuen Co.
Methuen	Alfred Sagar	Arlington Cotton Mills.
Millbury	Fred W. Moore	Cordis Mills.
Millbury	Francis H. Rice	Holbrook Mfg. Co.
Millis	W. Marshall Taylor	National Flax Fibre Co.
New Bedford	Christopher P. Brooks	International Correspondence School
New Bedford	Richard Cowell	290 Summer St.
New Bedford	William W. Crapo	Wamsutta Mills.
New Bedford	Mark B. Creed	Wamsutta Mills.
New Bedford	Andrew J. Currier	Kilburn Mills.
New Bedford	John A. Fernley	Butler Mill.
New Bedford	Frederick Grinnell	Gen. Fire Extinguisher Co.
New Bedford	William Edwin Hatch	New Bedford Textile School.
New Bedford	Hiram Higham	Wamsutta Mills.
New Bedford	Henry A. Holcomb	Box 249.
New Bedford	Charles M. Holmes	Box 96.
New Bedford	Nathaniel B. Kerr	Butler Mill.
New Bedford	Walter H. Langshaw	Dartmouth Manufg. Corp.
New Bedford	John H. Lawrence	Top Roll Mfg.
New Bedford	Frederick B. Macy	Soule Mills.
New Bedford	John McCullough	Cotton Waste Merchant.
New Bedford	John Neild	Grinnell Mfg. Corp.
New Bedford	H. W. Nichols	New Bedford Textile School.
New Bedford	Walter H Paige	Wamsutta Mills.
New Bedford	Albert R. Pierce	Pierce Mfg. Corp.
New Bedford	Andrew G. Pierce, Jr.	Pierce Mfg. Corp.
New Bedford	Lavater W. Powers	141 Merrimac St.
New Bedford	Frederick W. Reynolds	Potomska Mills.
New Bedford	Lewis T. Shurtleff	Pairpoint Corp.
New Bedford	Rufus A Soule	Soule Mills.
New Bedford	Samuel Taylor	Soule Mill.
New Bedford	Herbert E. Walmsley	Wamsutta Mills.
New Bedford	Lettice R. Washburn	235 North Water St.
New Bedford	William R. West	830 Purchase St.

New Bedford	Benjamin Wilcox	City Mfg. Co.
New Bedford	Samuel F. Winsper	City Mfg Co.
Newton	Josiah G. Coburn	99 Washington St.
Newton Centre	Henry B. Ashton	S. A. Felton & Son Co.
Newtonville	Oscar B. Truesdell	18 Washington Terrace.
Newton Upper Falls	Frank J. Hale	Saco and Pettee Machine Shops.
Newton Upper Falls	R. Paul Snelling	Saco and Pettee Machine Shops.
North Adams	Hervey Burnham	Beaver Mills and Eclipse Mill.
Northbridge	Earl S. Jenckes	Paul Whittin Mfg. Co.
Northbridge	Henry T. Whitin	Paul Whitin Manufg. Co.
Northbridge	Paul Whitin	Paul Whitin Mfg. Co.
Northampton	Charles E. Childs,	West Boylston Co.
North Oxford	Edwin N. Bartlett	Sigourney and Rockdale Mills.
North Plymouth	Gideon F. Holmes	Plymouth Cordage Co.
Norwood	Henry William Stone	Holliston Mills.
Ponkapoag	Willis S. Shepard	American Net & Twine Co.
Readville	George P. Erhard	The Geo. W. Stafford Co.
Salem	C. F. Curwen	Dinsmore Mfg. Co.
Salem	William P. McMullan	Naumkeag Steam Cotton Co.
Salem	Henry Osgood	P. O. Box 204.
Salem	Nathaniel G. Simonds	Naumkeag Steam Cotton Co.
Shattuckville	Frank S. Field	Massaemit Yarn Mills.
Somerville	Albert Birch	Birch Bros. Co.
South Hadley Falls	Charles W. Dennett	So. Hadley Mills.
South Hadley Falls	Harlan Ingalls Dennett	Hadley Mills.
Springfield	Joseph M. Dunham	43 Edwards St.
Spring Hill	Justin A. Ware	
Taunton	A. C. Bent	Safety Seamless Pocket Co.
Taunton	William H. Bent	Mason Machine Works.
Taunton	Raymond D. Borden	Watuppa Mills.
Taunton	Peter H. Corr	Greenwich Bleachery.
Taunton	Thomas G. Cox	Mason Machine Works.
Taunton	H. H. Culver	Elizabeth Poole Mills.
Taunton	Henry S. Culver	Westville Cotton Mills.
Taunton	Eugene Finocchiaro	Cohannet Mills.
Taunton	S. L. Gabriel	U. S. Linen Co.
Taunton	Allan B. Greenough	Harrison Yarn and Bleaching Co.
Taunton	Jesse A. Knight	Cohannet Mills.
Taunton	Henry M. Lovering	Whittenton Manufg. Co.
Taunton	Charles L. Macomber	Winthrop Cotton Yarn Co.
Taunton	John Tempest Meats	Mason Machine Works.
Taunton	Herbert H. Shumway	Corr Manufg. Co.
Taunton	James W. Taylor	
Taunton	Henry Williams	Canoe River Mill.
Thorndike	Charles H. Hobbs	Thorndike Co.
Thorndike	Charles A. Tabor	Thorndike Mills.
Three Rivers	Roscius C. Newell	Palmer Mill.

Turners Falls	Samuel L. Parker	Turners Falls Cotton Mills.
Waltham	Charles E. Getchell	Waltham Emery Wheel. Co
Waltham	Arthur S. Paul	Boston Mfg. Co.
Ware	George E. Tucker]	The Otis Co.
Webster	Frank Hartley	S. Slater & Sons.
Webster	E. P. Morton	Stevens Linen Works.
Webster	William J. Stewart	S. Slater & Sons Inc.
West Warren	A. G. Harris	West Warren Cotton Mills.
West Warren	George A. Moody	West Warren Cotton Mills.
Whitinsville	Alfred E. Adams	Whitinsville Cotton Mills and Linwood Mills.
Whitinsville	Melvin H. Coffin	Whitin Machine Works.
Whitinsville	Lawrence M. Keeler	Whitin Machine Works.
Whitinsville	Josiah M. Lasell	Whitin Machine Works.
Whitinsville	E. Kent Swift	Whitin Machine Works.
Whitinsville	Oscar L. Owen	Whitin Machine Works.
Whitinsville	Cyrus A. Taft	Whitin Machine Works.
Whitinsville	Arthur F. Whitin	Saunders Cotton Mills.
Whitinsville	G. Marston Whitin	Whitin Machine Works.
Whitinsville	James Earle Whitin	Uxbridge Cotton Mills.
Williamstown Sta.	Roland R. Kelly	Williamstown Manufg. Co.
Worcester	George L. Brownell	Inventor and Builder of Improved Twisting Machinery.
Worcester	George Crompton	Crompton-Thayer Loom Co.
Worcester	Randolph Crompton	Crompton-Thayer Loom Co.
Worcester	Henry F. Harris	W. Boylston Mfg. Co.
Worcester	Lewis T. Houghton	997 Main St.
Worcester	A. H. Howard	Howard Bros. Mfg. Co.
Worcester	C. H. Hutchins	Crompton & Knowles Loom Works
Worcester	Geo. E. Prest	104 Harrison St.
Worcester	John E. Prest	340 Highland St.
Worcester	Geo. I. Rockwood	62 Summer St.
Worcester	Wm. B. Scofield	Crompton-Thayer Loom Co.
Worcester	J. F. Warren	J. F. & W. H. Warren Co.
Worcester	W. W. White	Holyoke Machine Co.

RHODE ISLAND.

Allenton	R. A. Gray	Rodman Manufg. Co.
Anthony	Frank F. Wooley	Coventry Co.
Ashton	Charles H. Collins	Berkeley Co.
Ashton	Robert Stewart	Lonsdale Co.
Central Falls	Louis B. Barker	United States Cotton Co.
Central Falls	David Grove	United States Cotton Co.
Central Falls,	B. F. G. Linnell,	Yarns, Threads and Twines.
Centreville	James T. Ferguson	Warwick Mills.
Crompton	Charles D. Robinson	Crompton Co.
Davisville	Walter B. Knight	

Fiskville	James Gee	Interlaken Dye Works.
Forestdale	Alphonso F. White	Forestdale Mfg. Co.
Georgiaville	A. E. Bosworth	Bernon Mills.
Hamilton	Joseph Warren Greene	Hamilton Web Co.
Longmeadow	Abel T. Atherton	Machine Maker.
Longmeadow	W. G. Hartford	
Lonsdale	Edward A. Mongeon	Lonsdale Mills.
Lonsdale	R. Irving Tobey	
Manville	A. Tenny White	Manville Co.
Natick	Andrew W. McAllister	Natick Mills.
Pawtucket	V. T. Barber	Slater Cotton Co.
Pawtucket	William Washington Blades,	Lorraine Mfg. Co.
Pawtucket	E. R. Bullock	J. & P. Coats, Ltd.
Pawtucket	Robert Burgess	Slater Cotton Co.
Pawtucket	William P. Dempsey	Dempsey Bleachery & Dye Works.
Pawtucket	Henry C. Dexter	Greene & Daniels Mfg. Co.
Pawtucket	Fred W. Easton	Easton & Burnham Machine Co.
Pawtucket	D. A. Everly	Cotton Mfr.
Pawtucket	Charles E. Harrison	Harrison Yarn and Dyeing Co.
Pawtucket	David Jackson	Jackson Pat. Shell Roll Co.
Pawtucket	J. E. Jenckes	The E. Jenckes Manufg. Co.
Pawtucket	John T. Kirk	Slater Cotton Co.
Pawtucket	James R. MacColl	Lorraine Manufg. Co.
Pawtucket	E. R. Richardson	Howard & Bullough American Machine Co., Ltd.
Pawtucket	Dwight Seabury	12 East Ave.
Pawtucket	S. Willard Thayer	Dexter Yarn Co.
Pawtucket	Fred A. Wilde	A. T. Atherton Machine Co.
Peace Dale	William C. Greene	Peace Dale Manufg. Co.
Phenix	Henry R. Brown	Phenix Mill.
Pontiac	Walter B. Hall	Pontiac Mill, B. B. and R. Knight.
Providence	Charles T. Aldrich	Aldrich Manufg. Co.
Providence	William Ames	Fletcher Mfg. Co.
Providence	George R. Babbitt	American Oil Co.
Providence	Edward R. Ballou	Ballou Yarn Co.
Providence	J. Frank Braids	Charles S. Bush Co.
Providence	H. Martin Brown	U. S. Bobbin & Shuttle Co.
Providence	E. C. Bucklin	Interlaken Mills.
Providence	Harris H. Bucklin	Interlaken Mills.
Providence	Charles H. Child	Standard Mill Supply Co.
Providence	Frederick I. Dana	The Textile Machinery Finishing Co.
Providence	A. Lockwood Danielson	Quinebaug Co.
Providence	J. DeForest Danielson	Lockwood Co. and Lewiston Bleachery and Dye Works.
Providence	John W. Danielson	Lockwood Co., Ponemah Mills, Quinebaug Co., Wauregan Co., & Lewiston Bleachery & Dye Works.

Providence	F. C. Fletcher	Lawton Spinning Co.
Providence	J. Herbert Foster	10 South Water St.
Providence	Arthur C. Freeman	Textile Finishing Machinery Co.
Providence	William Gammell	Berkeley Co.
Providence	R. H. I. Goddard, Jr.	Goddard Bros.
Providence	Rufus B. Goff	Standard Mill Supply Co.
Providence	John H. Hambly	Quidnick Mfg. Co.
Providence	A. Walter Harris	A. W. Harris Oil Co.
Providence	Elisha H. Howard	Cotton Goods Broker.
Providence	Frederic W. Howe	Crompton & Knowles Loom Works.
Providence	Daniel Jackson	B. B. & R. Knight.
Providence	Albert F. Knight	Box 835.
Providence	John E. Kendrick	American Supply Co.
Providence	Stephen A. Knight	Hebron Manufg. Co.
Providence	Webster Knight	B. B. & R. Knight's Mills.
Providence	W. C. Langford	86 Weybosset St.
Providence	Henry F. Lippitt	Social and Manville Cos.
Providence	Charles R. Makepeace	Box 973.
Providence	Henry W. Mason	10 South Water St.
Providence	F. H. Maynard	Gen. Fire Extinguisher Co.
Providence	Thomas Mayor	Thomas Mayor & Son.
Providence	John G. McFadden	Nottingham Mill.
Providence	Charles H. Merriman, Jr.	Manville Co.
Providence	William C. Peirce	Elizabeth Mills.
Providence	Stephen Minot Pitman	Narragansett Mutual Fire Ins. Co.
Providence	Charles A. M. Praray	Chas. A. M. Praray & Co.
Providence	Robert Schaellibaum	Rob Schaellibaum Co.
Providence	Frank P. Sheldon	Industrial Trust Building.
Providence	Harry M. Smith	Standard Mill Supply Co.
Providence	Wilton H. Spencer	7 Exchange Place.
Providence	Daniel J. Sully	T. M. Reynolds & Co.
Providence	Robert W. Taft	Coventry Co.
Providence	Charles F. Taylor	Burgess Cop Tube Co.
Providence	D. M. Thompson	F. W. Reynolds Co.
Providence	James T. Thornton	Thornton Machinery Co.
Providence	H. A. Tillinghast	The Textile Finishing Machinery Co
Providence	A. Curtis Tingley	National Ring Traveler Co.
Providence	W. O. Todd	Lawton Spinning Co.
Providence	Robert B. Treat	Manufacturers' Fuel Co.
Providence	William P. Vaughan	Putnam Mfg. Co.
Quidnick	O. B. Parker	Quidnick Mfg. Co.
Riverpoint	Arthur F. Brackett	Royal Arctic and Valley Queen Mills
Valley Falls	Arthur H. Gulliver	Samoset Co.
Valley Falls	Edward B. Jennings	Samoset Co.
Warren	Arnold Schaer	Warren Manufg. Co.
Westerly	Robert Dow	Solway Mills.
Westerly	A. E. Henry	Solway Mills.

Westerly	Robert B. Meikle	Lorraine Mfg. Co.
Woonsocket	L. W. Campbell	Woonsocket Machine and Press Co.
Woonsocket	Malcolm Campbell	Woonsocket Mach. & Press Co.
Woonsocket	William Halliwell	Providence and Woonsocket Mill of the Lawton Spinning Co.
Woonsocket	Edward W. Houghton	Globe Mill, Manville Co.
Woonsocket	Henry S. Houghton, Sr.	61 Pond St.
Woonsocket	Albert C. Hoy	
Woonsocket	William N. Kimball	Social and Nourse Mills.
Woonsocket	Frederick Ott	Hamlet Textile Co.
Woonsocket	Hadley D. Perkins	Sharp, Perkins & Co.
Woonsocket	Charles E. Thomas	Forestdale Mfg. Co.

CONNECTICUT.

Ansonia	Lewis H. Russell	Ansonia Co.
Baltic	Harold Lawton	Baltic Mills Co.
Danielson	Gordon A. Johnstone	Danielson Cotton Co.
Danielson	Emory S. Rathburn	
Danielson	James Herbert Smith	Quinebaug Co.
Jewett City	Frederick D. Ballou	W. A. Slater Mills.
Jewett City	James O. Sweet	Ashland Cotton Co.
Jewett City	Adelbert R. Young	Ashland Cotton Co.
Killingly	H. C. Atwood	Williamsville Manufg. Co.
Killingly	W. E. Atwood	Williamsville Manufg. Co.
Killingly	C. H. Truesdell	Attawaugan Co.
Middletown	Henry D. Martin	I. E. Palmer's Cotton Spin. Mills.
Middletown	Joseph Merriam	Springfield Webbing Co.
Middletown	J. F. Powers	Spinning Mill.
New Haven	George S. Barnum	The Bigelow Co.
Norwich	W. N. Blackstone	Attawaugan Co. and Totokett Mills Co.
Norwich	W. R. Burnham	
Norwich	C. H. Frisbie	Attawaugan Co. Arista Mills Co.
Norwich	W. G. Henderson	Falls Co.
Norwich	Alexander F. Hobbs	U. S. Finishing Co.
Norwich	Wm. I. Woodward	Shetucket Co.
Putnam	George W. Holt	Monohansett Manufg. Co.
Putnam	George A. Vaughan	Putnam Manufg. Co.
Sterling	Harold D. Mowry	U. S. Finishing Co.
Taftville	Joseph D. Aiken	Ponemah Mills.
Taftville	John Eccles	Ponemah Mills.
Uncasville	Robert G. McMeehan	Uncasville Mfg. Co.
Voluntown	George T. Briggs	The Briggs Mfg. Co.
Wauregan	James A. Atwood	Wauregan Co. & Quinebaug Co.
Wauregan	John Walter Atwood	Wauregan Co.
Willimantic	Peter Hardman	American Thread Co., Willimantic Mills.

Willimantic	Dickerson G. Baker	American Thread Co.
Willimantic	E. S. Boss	American Thread Co.
Willimantic	Joseph Mercer	Willimantic Cotton Mills Co.
Windsor Locks	George M. Montgomery	The J. R. Montgomery Co.
Windsor Locks	J. R. Montgomery	The J. R. Montgomery Co.

NEW YORK.

Brooklyn	Hugh De Haven	De Haven Mfg Co.
Capron	W. H. Cloher, Jr.	Utica Cotton Co.
Chadwicks	Bradford C. Divine	Utica Willowvale Bleaching Co.
Cohoes	David S. Johnston	Harmony Mills.
Cohoes	Henry C. Phillips	Harmony Mills.
Cohoes	William H. Robinson	No. 3 Harmony Mill.
Elmira	William H. Bilbrough	Elmira Knitting Mills and Conewawah Spinning Co.
Jamestown	Thomes Henry Smith	Jamestown Cotton Mill.
Newburgh	William J. Hadfield	124 Smith St.
New York City	Robert Franklin Adams	106 Grand St.
New York City	George Arms	Grand Hotel.
New York City	Edwin H. Baker	Bliss, Fabyan & Co.
New York City	D. C. Ball	5 Beekman St.
New York City	Percy H. Brundage	49 Wall St.
New York City	Albert C. Case	25 Broad St. Room 1213.
New York City	J. E. Cheesman	Cheesman Cotton Gin Co.
New York City	C. C. Cowan	27 William St.
New York City	Charles Henry Davis	25 Broad St.
New York City	L. L. Flemming	American Cotton Co.
New York City	E. C. Foerster	415 Broadway.
New York City	Frederick Stewart Greene	American Mfg. Co.
New York City	William M. Lovering	24 Thomas St.
New York City	Arthur B. Mann	J. H. Martin & Co.
New York City	John R. Mitchell	Mitchell-Bissell Co.
New York City	S. F. B. Morse	Southern Cotton Corporation.
New York City	Arthur Parkinson	Arabol Mfg. Co.
New York City	Duncan D. Parmly	Johnson Mfg. Co. & Dunbar Mills Co.
New York City	Vladimir P. Polevoy	120 Broadway
New York City	Chas. F. Pray	Cloth Broker.
New York City	Theodore H. Price	Cotton Dealer.
New York City	William N. Shaw	The Lincoln Iron Works & Jackson Architectural Iron Works.
New York City	George A. Wies	Eureka Fire Hose Co.
New York Mills, Oneida Co.,	John P. Campbell,	New York Mills.
Oswego	George E. Farrell	Ontario Knitting Co.
Syracuse	Sanford E. Loring	341 Delaware St.
Utica	John W. Allis	Utica Knitting Co.

Utica	George DeForest	Utica Steam and Mohawk Valley Cotton Mills.
Utica	D. W. Gray	Skenandoa Cotton Co.
Utica	Henry F. Mansfield	Utica Steam Cotton Mills and Mohawk Valley Cotton Mills.
Utica	Pardon B. Sanford	Utica Kniting Co.
Utica	Albion K. Searls	Oneita Knitting Mills.
Utica	John B. Wild	Oneita Knitting Mills.

NEW JERSEY.

East Newark	Halsey Connett	Clark Mile End Spool Cotton Co.
Gloucester	George W. Turner	Argo Mills Co.
Jersey City	Ernest Bridge	Jas. Chadwick & Bro. Ltd.
Jersey City	Maxwell Grierson	Jas. Chadwick & Bro., Ltd.
Jersey City	B. L. Stowe	Eureka Fire Hose Co.
Millville	John F. Reardon	Millville Mfg. Co.
Newark	William H. Loftus	Clark Thread Co.
New Brunswick	William Henry Hobbs	Johnson & Johnson Co.
New Brunswick	William H. Ritter	Johnson & Johnson.
Passaic	E. W. Davenport	Brighton Mills.
Passaic	Dudley T. Lyall	Brighton Mills.
Passaic	William L. Lyall	Brighton Mills.
Passaic	John W. Ramsbottom	Brighton Mills.
Paterson	J. E. Barbour	Barbour Flax Spinning Co.
Paterson	John W. Ferguson	Paterson Nat. Bank Bldg.

PENNSYLVANIA.

Chester	W. T. Galey	Aberfoyle Manufg. Co.
Chester	D. Edwin Irving	The Irving & Leiper Manufg. Co.
Chester	D. Irving Trainer	Agt. Lincoln Mfg. Co.
Frankford, Phila.	Walter R. Garsed	Wingohocking Cotton Mills.
Mt. Joy	Thomas J. Brown	George Brown's Sons.
Philadelphia	Robert Beatty	Robt. Beatty & Co.
Philadelphia	T. Ashby Blythe	Ashby Cotton Mills.
Philadelphia	Alfred H. Burnham	Glasgow Mills.
Philadelphia	Harry W. Butterworth	H. W. Butterworth & Sons.
Philadelphia	James Butterworth	H. W. Butterworth & Sons.
Philadelphia	Frederick A. Downes	Keystone Mutual Fire Insurance Co.
Philadelphia	Edward W. France	Philadelphia Textile School.
Philadelphia	Simon Friedberger	Friedberger Mfg. Co.
Philadelphia	Otto Goetze	Glasgow Mills, Kensington Station.
Philadelphia	John T. Greenwood	R. Greenwood & Bault.
Philadelphia	Henry S. Grove	Argo Mills Co.

Philadelphia	James Henry	Thomas Henry & Sons.
Philadelphia	Wililam G. Henry	Thomas Henry & Sons.
Philadelphia	W. C. Houston	Hope Mills Mfg. Co.
Philadelphia	John H. Lorimer	Ontario and Lawrence Sts.
Philadelphia	David Milne	Washington Ave and 10th & 11th Sts.
Philadelphia	Edward H. Sanborn	Cold Spring Bleach. & Fin. Works.
Philadelphia	Albert E. Schofield	Delph Spinning Co.
Philadelphia	William T. Westerman	Ontario Spinning Co.
Philadelphia	George Wood	Millville Mfg. Co.
Philadelphia	John P. Wood	521 N. 22nd St.
Philadelphia	Oscar W. Wood	Germantown Spinning Co.
Yardley	Theodore C. Search	Cold Spring Bleaching and Finishing Works.

DELAWARE.

Wilmington	William P. Bancroft	Joseph Bancroft & Sons Co.
Wilmington	Daniel Moore Bates	Joseph Bancroft & Sons Co.

MARYLAND.

Baltimore	E. Stanley Gary	Gary Mfg. Co.
Baltimore	James A. Gary	Gary Mfg. Co.
Baltimore	Wm. E. Hooper	Woodberry Division of Mt. Vernon Woodberry Co.
Baltimore	Charles K. Oliver	U. S. Duck Corporation.
Baltimore	E. W. Thomas	U. S. Duck Co.
Ilchester	Samuel F. Patterson	Thistle Mills Co.

VIRGINIA.

Danville	Harry W. Kimball	Riverside Cot. Mills.

NORTH CAROLINA.

Charlotte	Byron F. Card	Charlotte Machine Co.
Charlotte	E. N. Clemence	
Charlotte	Edward T. Garsed	
Charlotte	R. M. Miller, Jr.	Elizabeth Mills.
Charlotte	Daniel A. Tompkins	D. A. Tompkins Co.
Cooleeme	Henry J. Forsyth	Cooleeme Cotton Mill.
Fayetteville	Frank H. Cotton	
Fayetteville	Walter L. Holt	Holt-Morgan Mills.
Greensboro	Caesar Cone	Proximity Mfg. Co.
Greensboro	Farquharson J. Muir	Cone Export & Commission Co.
Hope Mills	Eben C. Willey	Hope Mills Mfg. Co.
Lincolnton	R. S. Reinhardt	Elm Grove Cotton Mills.
Mountain Island	W. T. Jordan	Mt. Island Manufg. Co.
Winston-Salem	John W. Fries	F. & H. Fries. & Arista Mills Co.

SOUTH CAROLINA.

Chester	William G. Nichols	Springstein Mills.
Columbia	Louis I. Guion	Columbia Mills Co.
Columbia	W. H. Rose	Richland, Granby & Olympia Cotton Mills.
Columbia	W. B. Smith Whaley	Richland & Granby Cotton Mills.
Graniteville	T. H. Rennie	Graniteville Mfg. Co.
Greenville	James B. Duggan	Union Bleaching and Finishing Co.
Lancaster	Leroy Springs	Lancaster Cotton Mills.
Langley	Arthur T. Smith	Langley Manufg. Co. and Aiken Manufg. Co.
Newberry	Edward B. Wilbur	Mollohon Mfg. Co.

GEORGIA.

Atlanta	W. L. Draper	Dodge Mfg. Co.
Atlanta	Harry K. Drew	Fulton Bag and Cotton Mills.
Atlanta	Oscar Elsas	Fulton Bag and Cotton Mills.
Atlanta	Henry E. Fisher	Atlanta Cotton Mills.
Atlanta	William M. Nixon	Atlanta Woolen Mills.
Augusta	Edward E. Bartlett	Sibley Mfg. Co.
Augusta	Thomas Barrett, Jr.	Langley & Aiken Mills.
Augusta	John W. Chafee	The Sibley Mfg. Co.
Augusta	T. I. Hickman	Graniteville Mfg. Co.
Augusta	Otis G. Lynch	Enterprise Manufg. Co.
Augusta	Peleg A. Rhodes	Cotton Mill Mutual Fire Ins. Co.
Augusta	Joel Smith	1311 15th St.
Augusta	George R. Stearns	Riverside Mills.
Chattahoochee	W. R. B. Whittier	Whittier Mills.
Columbus	Frederick B. Gordon	Columbus Mfg. Co.
Columbus	Charles H. Gorton	Columbus Mfg. Co.
Columbus	Walter Rigby	Bibb Mfg. Co.
Columbus	George W. Towne	Columbus Power Co.
Commerce	Charles M. Sears	Harmony Grove Cotton Mills.
East Point	Edward C. Beach	Gate City Cotton Mills.
Griffin, Spalding Co.	Albert G. Martin	Kincaid Manufg. Co.
Lawrenceville	C. Enos Bean	Lawrenceville Mfg. Co.
Lawrenceville	Albert E. McDonald	Lawrenceville Mfg. Co.
Lindale	Henry P. Meikleham	Mass. Mills in Georgia.
Macon	Henry C. Dresser	Bibb Mfg. Co.
Macon	H. B. Hopson	Bibb Mfg. Co.
Macon	Logon Owen	Bibb Mfg. Co. Mill No. 1.
Macon	Broadus E. Willingham	Willingham Cotton Mills.

TENNESSEE.

Knoxville	William T. Lang	Brookside Mills.
Memphis	William Dresser Edwards	Randolph Bldg.
Memphis	Jerome Hill	Jerome Hill Cotton Co.
Sherman Heights	Albert Deabill	Davis Hoisery Mills.

ILLINOIS.

Rockford	Howard D. Colman	Barber-Colman Co.

MISSISSIPPI.

Agricultural College	Harry D. Lord	Mississippi Textile School.
Agricultural College	William E. Winchester	Mississippi Textile School.
Meridian	John H. Ledyard	Meridian Cotton Mills.
Starkville	J. D. Mallory	John M. Stone Cotton Mill.
Starkville	Arthur Whittam	John M. Stone Cotton Mills.

LOUISIANA.

New Orleans	Lewis Dexter, Jr.	Maginnis Cotton Mills.
New Orleans	S. Odenheimer	Lane Mills.

KENTUCKY.

Henderson	Paul J. Marrs	Henderson Cotton Mills.
Louisville	O. W. Stiles	Louisville Cotton Mills Co.
Louisville	Philip S. Tuley	Louisville Cotton Mills Co.

ALABAMA.

Cordova	Scott Maxwell	Indian Head Mills of Ala.
Pell City	Arthur J. Draper	Pell City Mfg. Co.
Pell City	James R. Pearce	

CANADA.

Province of Ontario.

Cornwall	S. Greenwood	The Canadian Colored Cotton Mills Co., Ltd.
Hamilton,	Charles Owen Dexter	The Candian Colored Cotton Mills Co., Ltd.
Hamilton	George O. Dexter	Canadian Colored Cotton Mills Co., Ltd.
Hamilton,	James M. Young	Hamilton Cotton Co.
Ottawa	Louis Simpson	Victoria Chambers.

Province of Quebec.

Montreal	Alfred Hawkesworth	Merchants Cotton Co.
Montreal	Fred Hawkesworth	Merchants Cotton Co.
Montreal	Henry S. Houghton, Jr.	Merchants Cotton Co.
Montreal	D. K. McLaren	751 Craig St.
Montreal	A. B. Mole	Dominion Cotton Mills Co.
Valleyfield	Ernest E. Clark	Montreal Cotton Co.
Valleyfield	Fred Lacey	Montreal Cotton Co.
Valleyfield	Charles H. Potter	Montreal Cotton Co.
Valleyfield	Lewis J. Young	Montreal Cotton Co.

NEW BRUNSWICK.

St. John	John B. Cudlip	Cornwall and York Cotton Mills Co.

ENGLAND.

Huddersfield	John Sykes	English Card Clothing Co.
Manchester	William Myers	Technical School.
Manchester	William F. Parish, Jr.	Vacuum Oil Co. (Tech. Dept.)
Matlock, Derbyshire,	John Edward Lawton	American Thread Co.
Oldham	Robert Taylor Jr.	Asa Lees & Co., Ltd.

RUSSIA.

Moscow	Vladimir F. Gnesin	The Great Yaroslavl Mfg. Co.
Moscow	Vladimir Malinin	Prochoroff Three Hill Mfg. Co.

JAPAN.

Hiogo	Hachiro Henry Fukuhara	Sumoto Mill, Kanegafuchi Spinning Co.

RECAPITULATION.

LOCATION OF MEMBERSHIP.

Maine	19
New Hampshire	28
Vermont	1
Massachusetts	374
Rhode Island	111
Connecticut	36
New York	42
New Jersey	15
Pennsylvania	28
Delaware	2
Maryland	6
Virginia	1
North Carolina	14
South Carolina	9
Georgia	28
Tennessee	4
Illinois	1
Mississippi	5
Louisiana	2
Kentucky	3
Alabama	3
Province of Ontario	5
Province of Quebec	9
New Brunswick	1
England	5
Russia	2
Japan	1
	755

IN MEMORIAM.

JOSEPH S. TIDD.

JOSEPH S. TIDD was born in Warren, Mass., January 23, 1843. He was employed in the Warren Cotton Mills and was in the United States service during the Civil War with the Forty-Third Massachusetts Regiment.

In 1874 he accepted a position in the mills of A. F. Howard & Son of Taunton, which became the Oakland Mills in 1883; of which he was treasurer and agent until his death on October 5, 1904.

His relations with various organizations indicate the respect and confidence in which he was held by the community, as he was a trustee of the Taunton Savings Bank, a member of the Union Congregational Church, and also of the Grand Army of the Republic.

He is survived by a widow, two sons and a daughter.

He became a member of the New England Cotton Manufacturer's Association, April 27, 1899.

GEORGE E. KENT.

GEORGE EDWARD KENT was born at Somersworth, N. H., December 30, 1857, being the only son of Hon. HERVEY KENT, one of the few surviving charter members of this Association.

In 1893, the George W. Stafford Manufacturing Company was consolidated with the Knowles Loom Works, which was later absorbed by Crompton & Knowles; Mr. STAFFORD remaining as General Manager of the Providence works. A little over three years ago he severed his connection with Crompton & Knowles, going to Readville, Mass., where he established the George W. Stafford Company, of which concern he was General Manager until his retirement from active business on account of ill health in February, 1904.

He became a member of the New England Cotton Manufacturers' Association, April 24, 1895.

PROCEEDINGS.

In accordance with the legal notice, the stated annual meeting of the Association was held in Chipman Hall, Boston, Mass., April 26th and 27th, 1905. The following 268 members and 108 guests were present.

LIFE MEMBERS.

ROBERT W. NEFF,
GEORGE I. ROCKWOOD,
ROBERT SCHAELLIBAUM,
C. J. H. WOODBURY.

ACTIVE MEMBERS.

JAMES W. AHMUTY,
JOSEPH D. AIKEN,
THOMAS ARMSTRONG,
WILLIAM F. ARTHUR,
H. C. ATWOOD,
GEORGE A. AYER,
NATHANIEL F. AYER,
J. W. BAILEY,
EDWARD R. BALLOU,
FREDERICK D. BALLOU,
LOUIS B. BARKER,
V. T. BARBER,
LEWIS E. BARNES,
DANIEL MOORE BATES,
JOSEPH P. BATTLES,
ROBERT BEATTY,
WILLIAM WASHINGTON BLADES,
A. E. BOSWORTH,
STEPHEN N. BOURNE,
FRANK A. BOWEN,
ARTHUR F. BRACKETT,
ALBERT W. BRAINERD,
CHRISTOPHER P. BROOKS,
HENRY R. BROWN,
E. R. BULLOCK,
ROBERT BURGESS,
EDWARD N. BURKE,
ALFRED H. BURNHAM,

JOHN L. BURTON,
WILLIAM H CADWELL,
JOHN P. CAMPBELL,
ALFRED N. CHADWICK,
ELMER G. CHILDS,
JOSIAH G. COBURN,
FRANK B. COMINS,
JOHN J. CONNELL.
MARK B. CREED,
JOHN B. CUDLIP,
H. H. CULVER,
HENRY S. CULVER,
PHILIP DANA,
CHARLES W. DENNETT,
EDWARD P. DENNIS.
CHARLES A. DENNY,
P. Y. DENORMANDIE,
HENRY C. DEXTER,
ALBERT W. DIMICK,
EBEN S. DRAPER,
GEORGE OTIS DRAPER,
JOHN H. DUNN,
FRANK J. DUTCHER,
RUSSELL W. EATON,
FREDERICK W. ELY,
JAMES C. ETESON,
CHARLES F. FARRAR,
JOHN A. FERNLEY,
WILLIAM FIRTH,
FREDERICK A. FLATHER,
M. F. FOSTER,
ARTHUR C. FREEMAN,
C. H. FRISBIE,
JAMES GEE,
CHARLES E. GETCHELL,
MARCELLUS GOULD,
GEORGE P. GRANT, Jr.
D. W. GRAY,
R. A. GRAY,
JOSEPH WARREN GREENE,
S. HAROLD GREENE,
JOHN GREGSON,
DAVID GROVE,
ARTHUR H. GULLIVER,
WALTER B. HALL,
WILLIAM E. HALL,
Z. D. HALL,
JOHN F. HAMLET,
FRANK HARTLEY,
WILLIAM D. HARTSHORNE,
WALTER M. HASTINGS,
CHESTER D. HATCH,
WILLIAM E. HATCH,
WILLIAM B. HAWES,
WILLIAM HAYES,
ARTHUR N. HERSOM,
ERNEST L. HERSOM,
CHARLES H. HOBBS,
FRANKLIN W. HOBBS,
CHARLES M. HOLMES,
GEORGE W. HOLT,
WILLIAM P. HOLT,
OTIS L. HUMPHREY,
EARL S. JENCKES,
LEONARD JOHNSON,
DAVID S. JOHNSTON,
ROLAND R. KELLEY,
NATHANIEL B. KERR,
JOHN T. KIRK,
JESSE A. KNIGHT,
STEPHEN A. KNIGHT,
FRED LACEY,
HAROLD LAWTON,
CALVIN H. LEE,
EVAN ARTHUR LEIGH,
CHARLES F. LIBBY,
WILLIAM H. LOFTUS,
ARTHUR B. LOWE,
ERNEST LOVERING,
CHARLES B. LUTHER,

WILLIAM L. LYALL,
RONALD T. LYMAN,
JAMES R. MACCOLL,
FREDERICK B. MACY,
ALEXANDER MAKEPEACE,
HENRY F. MANSFIELD,
HENRY D. MARTIN,
THOMAS MAYOR,
ROBERT MCARTHUR,
WILLIAM G. MCLOON,
ROBERT G. MCMEEHAN,
WILLIAM P. MCMULLAN,
R. M. MILLER, Jr.,
ROSCOE S. MILLIKEN,
EDWARD A. MONGEON,
J. R. MONTGOMERY,
FRED W. MOORE,
GEORGE B. MORISON,
ALBERT H. MORTON,
E. P. MORTON,
JOHN NEILD,
WILL NELSON,
ROSCIUS C. NEWELL,
ALBERT W. NOONE,
WILLIAM B. ORR,
HENRY OSGOOD,
O. B. PARKER,
WALTER E. PARKER,
ARTHUR H. PAUL,
WILLIAM C. PEIRCE,
HAVEN C. PERHAM,
CHARLES T. PLUNKETT,
CHARLES H. POTTER,
GEORGE E. PREST,
JOHN E. PREST,
M. W. QUINN,
ROBERT REDFORD,
FRANCIS H. RICE,
CHARLES H. RICHARDSON,
BENJAMIN H. ROBERTS,
ALFRED SAGAR,
ARNOLD B. SANFORD,
PARDON B. SANFORD,
ALBION K. SEARLES,
THOMAS C. SHELDON,
HERBERT H. SHUMWAY,
J. C. SMITH,
WILTON H. SPENCER,
GEORGE E. SPOFFORD,
T. B. STEVENSON,
ROBERT STEWART,
WILLIAM J. STEWART,
WALTER F. STILES,
JOHN SULLIVAN,
TIMOTHY SULLIVAN,
WALTER H. SUMMERSBY,
JAMES O. SWEET,
JAMES W. TAYLOR,
SAMUEL TAYLOR,
W. MARSHALL TAYLOR,
RICHARD THACKERY,
EARL A. THISSELL,
CHARLES E. THOMAS,
D. M. THOMPSON,
R. IRVING TOBEY,
GEORGE W. TOWNE,
C. H. TRUESDELL,
OSCAR B. TRUESDELL.
GEORGE E. TUCKER,
A. TENNY WHITE,
GEORGE F. WHITTEN,
JOHN B. WILD,
EBEN C. WILLEY,
HENRY WILLIAMS,
ELIAS S. WILLIS,
FRANK F. WOOLEY,
ADELBERT R. YOUNG.

ASSOCIATE MEMBERS.

EUGENE C. ANDRES,
HENRY B. ASHTON,
HENRY ASHWORTH,
EDWIN BARNES,
COLIN C. BELL,
ALBERT BIRCH,
F. H. BISHOP,
EDMUND E. BLAKE,
ARTHUR T. BRADLEE,
J. FRANK BRAIDS,
HENRY GORDON BRINCKERHOFF,
H. MARTIN BROWN,
JOHN H. BURGHARDT,
CHARLES B. BURLEIGH,
EUGENE E. BURNHAM,
ARTHUR CECIL BUTLER,
L. W. CAMPBELL,
MALCOLM CAMPBELL,
W. W. CAREY,
CHARLES H. CHILD,
MELVIN H. COFFIN,
HOWARD D. COLMAN,
C. F. CURWEN,
JOSEPH L. CUSHING,
DANIEL J. DANKER,
JOHN O. DEWOLF,
FREDERICK N. DILLON,
C. E. W. DOW,
G. B. EMMONS,
GEORGE P. ERHARD,
H. P. GARLAND,
ROYAL W. GATES,
RUFUS B. GOFF,
ARTHUR F. GRAY,
ALFRED H. HARTLEY,
EDWARD F. HATHAWAY,
CHARLES W. HEDRICK,
HENRY S. HOUGHTON, Sr.,
LEWIS T. HOUGHTON,
A. H. HOWARD,
FREDERICK W. HOWE,
LAWRENCE M. KEELER,
FRANK B. KENNEY,
JOSEPH C. KING,
W. C. LANGFORD,
JOHN H. LAWRENCE,
STEPHEN C. LOWE,
FRANCIS E. MACOMBER,
JOHN P. MARSTON,
FAY H. MARTIN,
JOHN MCCULLOUGH,
H. G. MCKERROW,
MELDON H. MERRILL,
JOHN R. MITCHELL,
CHARLES B. MOORE,
WILLIAM R. NOONE,
THOMAS J. O'KEEFE,
SIDNEY B. PAINE,
ARTHUR PARKINSON,
JOHN PARMENIDES,
THEODORE H. PRICE,
FRANK W. REYNOLDS,
JOHN L. SANFORD,
DWIGHT SEABURY,
LEWIS T. SHURTLEFF,
HARRY M. SMITH,
H. E. STAFFORD,
JAMES STRANG,
ELWOOD E. TAYLOR,
GEORGE C. TEWKSBURY,
ALLISON W. TRAFFORD,
CLEMENT A. WAKEFIELD,

JUSTIN A. WARE,
WILLIAM WARR,
J. F. WARREN,
WILLIAM R. WEST,
W. W. WHITE,
FRED A. WILDE,
ERVING YALE WOOLLEY.

GUESTS.

WILLIAM G. ANTHONY, Providence, R. I.
A. A. ASPINWALL, Pawtucket, R. I.
E. E. AUSTIN, Providence, R. I.
F. I. BABCOCK, Boston, Mass.
H. J. BALLOU, Boston, Mass.
G. H. BELLOWS, Cambridge, Mass.
C. A. BOWEN, New Bedford, Mass.
A. P. BRANTLEY, Blackshire, Ga.
WALTER M. BREWSTER, Georgetown, Mass.
W. F. BROWN, Providence, R. I.
J. A. BRYANT, Boston, Mass.
E. G. CARSWELL, Boston, Mass.
RICHARD B. CLARK, Malden, Mass.
J. A. COOPER, Whitinsville, Mass.
W. P. COTHARIN, Boston, Mass.
W. W. CROSBY, Lowell, Mass.
W. M. CROWE, Lowell, Mass.
J. W. CURIT, Boston, Mass.
SAMUEL S. DALE, Boston, Mass.
GEORGE C. DANIELS, Boston, Mass.
MARCUS A. DAY, Taunton, Mass.
C. A. DEXTER, Valley Falls, R. I.
HENRY I. DODGE, Providence, R. I.
T. B. DOOLITTLE, Branford, Conn.
ALBERT DUCKSWORTH, Waltham, Mass.
L. J. ELLIS, New York City.
F. I. EMERY, Cambridge, Mass.
M. EMERY, Chicopee, Mass.
JAMES F. FLAHERTY, Philadelphia, Pa.
ROBERT FOSTER, Providence, R. I.
D. W. FOWLE, Newton, Mass.

E. M. FRASER, Fall River, Mass.
C. P. GAITHER, Boston, Mass.
M. E. GLEESON, Providence, R. I.
D. W. GRADY, Utica, N. Y.
E. A. GRAHAM, Cohoes, N. Y.
U. S. GRANGER, Providence, R. I.
R. V. GREGSON, Cambridge, Mass.
A. L. R. HAMBLY, Quidnick, R. I.
F. W. HANNAH, Boston, Mass.
E. H. HARRINGTON, Pawtucket, R. I.
C. H. HATHAWAY, Providence, R. I.
J. F. HAVEY, Boston, Mass.
J. G. HAWKES, Providence, R. I.
JOHN HOPE, Providence, R. I.
W. R. HORN, Lowell, Mass.
C. F. HOWARD, Boston, Mass.
H. M. HINES, Wyandotte, Mich.
J. B. JAMIESON, Boston, Mass.
E. M. JENNINGS, Boston, Mass.
RICHARD JOHNSON, Oldham, Eng.
JOHN JOHNSTON, Woonsocket, R. I.
EDWIN S. JONES, Philadelphia, Pa.
JAMES B. JONES, Philadelphia, Pa.
NATHANIEL KINSMAN, Boston, Mass.
S. W. KIRKLAND, Boston, Mass.
E. O. KNOWLES, New Bedford, Mass.
J. H. LAMB, Boston, Mass.
J. W. LANGSTREET, Somerville, Mass.
H. G. LORD, Boston, Mass.
R. N. MACKEY, Readville, Mass.
W. M. MACOMBER, Boston, Mass.
EDWIN H. MARBLE, Worcester, Mass.
A. A. MCAULIFFE, Fall River, Mass.
GEORGE MCDUFFEE, Utica, N. Y.
J. H. MCCORMACK, Boston, Mass.
J. T. MCWHIRTER, Wyandotte, Mich.
JOHN MERCHANT, Providence, R. I.
R. W. MERRICK, Boston, Mass.

CHARLES MESSENGER, Boston, Mass.
M. A. METCALF, Boston, Mass.
HERBERT MIDGELEY, Worcester, Mass.
H. B. MOWREY, Sterling, Conn.
W. A. MOYER, New York City.
C. M. MUMFORD, Providence, R. I.
GEORGE H. MURRAY, Fall River, Mass.
J. W. NASMITH, Manchester, England.
FRANK L. NAGLE, Boston, Mass.
JOHN O'CALLAGHAN, Boston, Mass.
F. G. PAGE, Pawtucket, R. I.
F. B. PERRY, Boston, Mass.
CHARLES W. PIERCE, Charlotte, N. C.
E. T. PIERCE, New Bedford, Mass.
J. G. F. RANDOLPH, Chelsea, Mass.
A. F. RAY, Boston, Mass.
A. F. RAYMOND, Boston, Mass,
C. P. RAYMOND, Boston, Mass.
C. A. READ, Durham, N. H.
A. F. SALMON, Lowell, Mass.
JOHN C. SHARPE, Jr., Taunton, Mass.
F. E. SHEDD, Boston, Mass.
GEORGE H. SHERMAN, Worcester, Mass.
CHARLES T. SLACK, Fall River, Mass.
FRED A. SMITH, Boston, Mass.
JOSEPH T. SMITH, New York City.
S. H. STEELE, New York City.
J. M. STEPHENSON, New York City.
JACOB STEVENS, Pawtucket, R. I.
W. Y. STIMPSON, Hopedale, Mass.
A. S. THOMAS, Lowell, Mass.
W. D. VANDYKE, New York City.
R. WASHBURN, Worcester, Mass.
R. E. WATTLES, Canton, Mass.
PHILIP C. WENTWORTH, Fall River, Mass.
F. W. WESTON, Boston, Mass.
JAMES W. WOOD, Boston, Mass.
W. D. WOOD, Providence, R. I.

FIRST SESSION.

CHIPMAN HALL, BOSTON, MASS.
WEDNESDAY, April 26, 1905.

The meeting was called to order at 11 A. M., President HERBERT E. WALMSLEY in the chair.

The PRESIDENT. The time appointed for the meeting of this convention having arrived, if you will please come to order the Secretary will read the call for the meeting.

The Secretary read the call for the meeting as follows:

BOSTON, MASS., April 1, 1905.

To the Members:

Notice is hereby given that the stated Annual Meeting of this Association will be held at Boston, Mass., Wednesday and Thursday, April 26 and 27, 1905.

In accordance with the notice given at the 77th Meeting, an amendment will be submitted, with the approval of the Board of Government, in accordance with Article 15 of the Constitution and By-Laws, viz:

Amend Article 8 by adding the words: "Unless sooner removed as hereinafter provided."

Article 10 by inserting after the words "resignation" in the eleventh line of said article the words: "or removal."

Insert after the word "meeting" in line thirteen of Article 10 the words: "except as hereinafter provided."

Insert new section as follows:

"Any officer who shall unreasonably absent himself from three consecutive meetings of the Board of Government of which he is a member, or shall otherwise neglect or refuse to perform the duties of his office, may be removed from office at any regular meeting of the Board of Government by a vote of a majority of the members present and voting thereon, a notice of such proposed action to be sent to him by mail at least one week previous to the meeting."

Two-thirds of the members present and voting thereon must vote in the affirmative in order to adopt the foregoing proposals.

Sessions will be held in Chipman Hall, in the Tremont Temple, No. 88 Tremont street, a short distance south of School street, and opposite the Tremont Building. The entrance is at No. 88 Tremont street, and Chipman Hall is on the sixth floor, reached by elevators.

The sessions will be called to order on Wednesday at 11 A. M., and 2 P. M., and on Thursday at 10 A. M., and 2 P. M.

By order of the Board of Government,

C. J. H. WOODBURY,
Secretary.

Hon. LOUIS A. FROTHINGHAM, Speaker of the House of Representatives, will welcome the Association and extend the greetings of the Commonwealth, on behalf of His Excellency, Governor DOUGLAS, who will be unable to attend the meeting.

The full programme will not be issued until the meeting, but papers are expected on the following subjects, and advance copies of any papers which are printed in time will be sent to any of the members on request.

Additional Top Stripper on Revolving Flat Cards.
Analysis of the Detaching and Piecing Processes in Combing Machines.
Barber Warp-Tying Machines.
Boiler Plants in Bleaching and Dyeing Mills.
Cloth Room and its Equipment.
Experiments in the Manufacture of Cotton Yarn.
Gray Goods for Clay Filled Work.
Measurements of Power Required in Manufacturing Heavy Cotton Goods.

Mill Ventilation and Its Influences.
Motor Drive as Applied to Cotton Mills.
New Classification of Color.
Progress in the Development of the Electric Drive.
Relationship Between the Planter and the Manufacturer: Its Unnecessary Antagonisms.
Static Electricity Neutralized.

And other papers of which the exact titles have not been received.

The souvenir badges will be given to those members who are in attendance, and the Board of Government has given instructions that duplicates shall not be given until after the adjournment, but other souvenir badges will be given to the guests of members.

It is trusted that the members will co-operate to the advantage of the Association in broadening its membership so that it may be as fully representative as possible of those engaged in the cotton manufacturing business and its tributary occupations, by calling to such persons the advantages of membership in the organization. Blank propositions for membership may be found on the inside of the front cover of the Transactions or will be sent on application.

The New England Cotton Manufacturers' Association Scholarship, established at the New Bedford Textile School by the donation of WILLIAM FIRTH, Esq., primarily for the benefit of a son of a member or deceased member, will be available the forthcoming year, as the present recipient of the Scholarship will graduate in June.

Candidates for this Scholarship will apply by letter only, addressed to the New England Cotton Manufacturers' Association, P. O. Box 3672, Boston, Mass.

The Board of Government especially hope that at this meeting the various papers will receive a full discussion and that inability to attend the meeting may not be considered by any one an impediment, as discussions may be written and sent to the Secretary to be read.

It is important that the Association should be promptly informed of the change of address of any members, in order that they may promptly receive their copies of Transactions.

Members who have overlooked their postal card receipts for Transactions are requested to give the matter attention, as it is only through this means that the headquarters of the Association are able to know that members receive the volumes and notices to which they are

entitled, and to keep an accurate record for sending Transactions and notices to members.

The International Committee of Master Cotton Spinners' and Manufacturers' Association have sent a number of copies of the report of proceedings of the first International Congress of Cotton Spinners and Manufacturers recently held at Zurich and the Board of Government has directed that these will be distributed to such members of the Association as may apply, on receipt of ten cents in postage stamps to pay Custom House duties and expenses of distribution.

Members who have overlooked payment of bills for dues are respectfully requested to give the matter attention.

The Secretary of this Association has been asked to co-operate with the representatives of other technical societies in furnishing technical cotton textile terms to the technical dictionary which is being prepared in Berlin in English, French and German and the Secretary respectfully asks the co-operation of any of the members, particularly in sending names of rare or obsolete cotton technical terms and if possible either French or German equivalents.

The estate of one of the members offers a complete set of the Transactions for one hundred dollars. Further information will be given by the Secretary.

The SECRETARY. Mr. President, I certify that in accordance with article 14 of the constitution and by-laws, a copy of this notice was mailed to each member ten days at least in advance of this meeting, and that a quorum is now present.

The programme for the meeting was as follows:

PROGRAMME.

First Session, Wednesday, April 26, 1905, at 11 A. M.

Call to Order.

Election of Officers.

Welcome to the Association.

Hon. LOUIS A. FROTHINGHAM, Speaker of the House of Representatives.

President's Address.
HERBERT E. WALMSLEY, New Bedford, Mass.

Presentation of testimonial to the Secretary.

Award of the Association Medal.
STEPHEN A. KNIGHT, *Chairman of Committee.*

Reports of the Secretary and Treasurer.

Business.

New Classification of Color.
A. H. MUNSELL, Boston, Mass.

Static Electricity Neutralized.
PHILIP DANA, Westbrook, Maine.

Second Session, Wednesday, April 26, 1905, at 2 P. M.

The Relationship between the Planter and the Manufacturer: Its Unnecessary Antagonisms.
THEODORE H. PRICE, 82 Beaver St., New York City.

Gray Goods for Clay Filled Work.
DANIEL MOORE BATES, Wilmington, Del.

Experiments in the Manufacture of Cotton Yarn.
STEPHEN E. SMITH, Lowell, Mass.

Mill Ventilation and Its Influences.
EBEN C. WILLEY, Hope Mills, N. C.

Third Session, Thursday April 27, 1905, at 10 A. M.

Analysis of the Detaching and Piecing Processes in Combing Machines.
JOHN W. NASMITH, 33 Barton Arcade, Manchester, Eng.

The Cloth Room and Its Equipment.
EDWIN MARBLE, Worcester, Mass.

Batten and Hayes Additional Top Stripper on Revolving Flat Card.
WILLIAM HAYES, Auburn, Maine.

The Barber Warp Tying Machine.
E. W. THOMAS, Columbia, S. C.

Boiler Plants in Bleaching and Dyeing Mills.
GEORGE I. ROCKWOOD, Worcester, Mass.

Fourth Session, Thursday, April 27, 1905, at 2 P. M.

Election of Members.

Progress in the Development of the Electric Drive.
SIDNEY B. PAINE, Boston, Mass.

Measurement of Power Required in Manufacturing Heavy Cotton Goods.
LOUIS I. GUION, Columbia, S. C.

Motor Drive as Applied to Cotton Mills.
MELDON H. MERRILL, Boston, Mass.

A limited number of tickets, each admitting the bearer with friends, including ladies, to the Seventy-second Exhibition of Paintings at the Boston Art Club, corner of Dartmouth and Newbury Streets, open from 9 A. M. to 10 P. M., may be obtained of the Secretary.

The PRESIDENT. The Secretary will now be good enough to read the records of the last meeting.

The Secretary read the records of the Seventy-seventh meeting of the Association, held at the Mount Washington Hotel, Bretton Woods, New Hampshire, September 21-22, 1904, and on motion of Mr. GEORGE OTIS DRAPER it was voted that the same be accepted and approved.

ELECTION OF OFFICERS.

The PRESIDENT. The next business in order, gentlemen, is the election of officers for the ensuing year.

The SECRETARY. It is my duty to report that the following offices expire by limitation:

PRESIDENT.

HERBERT E. WALMSLEY.

VICE-PRESIDENTS.

JAMES R. MACCOLL,
WILLIAM D. HARTSHORNE.

DIRECTORS FOR THREE YEARS.

J. R. MONTGOMERY,
WILLIAM D. PENNELL.

Mr. WILLIAM H. LOFTUS. I move you, sir, that a committee of three be appointed by the Chair to be a nominating committee to report later.

This motion was duly seconded and carried.

The PRESIDENT. As such a committee I will appoint ROBERT BURGESS as chairman, and PARDON B. SANFORD and GEORGE OTIS DRAPER, which committee will report tomorrow if agreeable.

Gentlemen of the Association, you will all, I am sure, agree with me that one of the most pleasing and agreeable features of the annual meetings of this Association held in this city is the welcome accorded to the Association by some prominent man of the Commonwealth.

It is now my agreeable duty and privilege to present to you the Hon. LOUIS A. FROTHINGHAM, Speaker of the Massachusetts House of Representatives, who will kindly welcome the Association to the Commonwealth on behalf of His Excellency Governor DOUGLAS.

ADDRESS OF WELCOME TO THE ASSOCIATION.

HON. LOUIS A. FROTHINGHAM.

Mr. President; members of the New England Cotton Manufacturers' Association :—As I appear here somewhat as an understudy I fear I cannot bring these words of welcome up to the high standard which your chairman says you have been used to in the past.

The last time I attended a meeting here was to address a Young Men's Baptist Association. I do not know whether I felt more at home there than I do appearing before this organization today. Apparently when anyone is designated as a speaker he is presumed to talk on almost any topic.

As a matter of fact I usually have to sit and listen all day to the oratory of some other gentleman, but there is one thing I learn from that, namely: not to speak at too great length.

It is a great pleasure to welcome this distinguished organization to Boston, and that Massachusetts desires to have you here is shown by the fact that the amendment to your charter, which gives you the privilege of meeting in any State or Territory throughout the Union, specifically provides that at least once in five years the annual meeting of the Association shall be held in Massachusetts. Can any words of mine add to this evidenee that Massachusetts is glad to see you.

It is appropriate, too, that you should meet here. Your Association stands for the advancement of the cotton industry and though Massachusetts does not produce a pound of cotton, she contains twice as many spindles as all the Southern States put together. It is appropriate also because your Association was organized here, and received its charter from the State. It

is appropriate because twelve miles from here, in Weymouth, the inventor of the cotton gin, ELI WHITNEY, was born.

Upon the success of this organization depends the welfare and happiness of a million of people throughout the United States, and you are doing a noble work towards the advancement and upbuilding of this success.

Legislation affecting the cotton industry dealing with the methods and hours of labor are of vital importance to you. The laws on that subject here are of a high and humane order.

It is manifestly difficult for those in New England to compete with the states where the laws are more lax than they are in this section of the country, and I want to call your attention to the fact of the great tendency at the present time towards national legislation on this and other important subjects towards the centralization of the power in the Federal Government to deal in some manner with these great questions.

In foreign countries the central government deals much more fully with legislation, and much more generally than the Federal Government does in this country. In France, for instance, in the matter of education there is much more uniformity, and the Minister of Instruction knows exactly what every child of a certain age at a given time is reading throughout that country.

The assumption by the national government of control over the railroads and great corporations shows the tendency towards centralization in the United States, and evinces the great latent power which our Congress possesses for legislating in relation to these questions.

Of course, as you all know, in many cases a constitutional amendment would be necessary to allow the Federal Government to assume jurisdiction over these great subjects, as they would not come under the clause in the constitution giving Congress power to legislate in matters affecting commerce between the states, and it is under that clause it gets authority to regulate railroads and corporations dealing in interstate commerce.

Legislation in regard to labor laws would hardly come

under that head in the constitution. Under no administration has this tendency towards centralization of power in the government at Washington been so manifest and so strengthened as it has under the administration of our present energetic and high-minded president THEODORE ROOSEVELT. [Applause]. Under his administration the laws dealing with these questions, such as the Sherman Anti-Trust Act and the Inter-State Commerce Act have been strengthened. Laws have been passed such as the Elkins Act, and acts for the rapid advancement of cases arising under these acts. A Department of Commerce and Labor has been established, and under it, a Bureau of Corporations.

In a recent message to Congress the President recommended investigation by the Department of Commerce of the labor laws of the various states, and the publication of these laws, hoping by this publicity to bring the various states more together on this question.

I suppose it is undoubted that it would be for the benefit of this Association, and for the New England cotton manufacturers to have uniform laws on this subject. It must be admitted too, I suppose, that there can be and must be no retrograde movement on this question.

The chances are that the states which have laxer laws than we have in this part of the country on this subject will grow up to our laws. Undoubtedly a constitutional amendment will be necessary to allow the national government to deal with the question, and if I am not mistaken a Congressman from this state has on one or more occasions proposed such an amendment.

A constitutional amendment however, is very difficult of enactment, as you all know; but whether by that means or the method the President proposes of publicity, the desired result of comity between various states is reached in regard to labor legislation, there is no question but it would be for the advantage of this Association and the cotton industry.

It is because of the great work your Association is doing,

because of its affiliation with this state, because of the learned and important discussions which you will have here in relation to the cotton industry, and because of the great importance of your industry to this country — that the Commonwealth is glad to welcome you here. [Great applause.]

PRESIDENT'S ADDRESS.

HERBERT E. WALMSLEY, New Bedford, Mass.

Gentlemen of the New England Cotton Manufacturers' Association :

It is with very great pleasure that I rise to address you upon this meaningful occasion, and as President of this Association, as well as on behalf of my colleagues on the Board of Government, to bid you all welcome — a very hearty welcome — to the 78th Convention of the Association.

At the same time permit me to remind you that these conventions are occasions for business advantages as well as for social intercourse.

I desire, also, to give expression to the hope that our coming together here, and in this manner, may be mutually beneficial and gratifying in every sense of the word.

I perhaps need hardly say that every member of the Association is entitled to participate in the discussions that will take place. You are cordially invited and earnestly urged to do so.

You are likewise requested to be in your places to vote upon the several questions that will come before you and claim your attention during the sessions about to be held.

In my judgment it is equally as important, gentlemen, that we should in these conventions discuss and deliberate upon the measures, and the policy of the measures pursued in the management and conduct of the industry, as it is to discuss the manufacture of cotton, the steam engine, electricity, or the many technical and other subjects in connection with the industry in general.

If there is any disposition to check this freedom of inquiry in

this particular, the firmer and more determined, I submit, should we be in the exercise of our undoubted prerogatives as individuals, and as an organization, to canvass without fear or favor the methods pursued by the trade in general, and by the men responsible for the well being of the trade.

We are, many of us, unfortunately, too apt to shut our eyes to unpleasant truths and facts, and too much disposed to be of the number of those who having eyes see not and having ears hear not some of the things which so nearly and so vitally concern the welfare and the future of the industry.

This Association should, in my judgment, discuss intelligently and dispassionately all current topics of especial interest to the cotton industry, both economic and industrial.

The strong and influential position held by our organization in the cotton world is cause for much satisfaction, and gives every promise of continued and increasing usefulness.

Our proceedings, as you well know, attract wide spread attention, and excite deep interest in the general business community; in fact, it is no exaggeration to say our meetings are of international interest.

Let us therefore, and in view of these facts, devote ourselves to the business before us with a zeal and an earnestness of purpose worthy the occasion and worthy the Association in which we, all of us, have one common interest, an Association that has become such a potent factor in the great trade of the country.

If our proceedings upon this occasion should promote the well being of the industry, we may well feel ourselves amply rewarded.

It is, gentlemen, with peculiar and lively satisfaction that I am able to congratulate you upon the improved and improving condition of trade.

The past two years in the cotton industry have been years of depression, and heavily weighted with anxiety, as we all only too well know.

Strikes, reductions of wages and of running time, much ma-

chinery stopped with curtailment of production in every direction is what we have experienced.

Through it all the cotton manufacturing industry of New England has in general stood substantially firm and steady; it has successfully withstood the test of two years' adversity, and if conducted on broad and sound lines, and in a spirit of fair play and equity, it can stand trial, it can stand assault, it can stand adversity.

The suggestion that New England's great staple industry is on the wane, on the decline, is worse than absurd; it is a reflection upon common sense.

No greater mistake can be made than to imagine there is anything to justify such a narrow, shortsighted conclusion.

On the contrary, established upon a solid foundation as it is, it will continue to play a far greater part in the future than it has done in the past, and will continue to be an important factor in the progress and prosperity of New England.

The present outlook, I rejoice to say is decidedly hopeful and encouraging, and I venture to express the hope, the belief, that the improvement in trade already manifest may be of so permanent and beneficial a character that we may again participate in an industrial and commercial prosperity no less great than the prosperity our friends across the water are now enjoying; a period of profitable activity unknown — if I am not mistaken — to the present generation of cotton mauufacturers over there.

It is not every one, perhaps, who realizes the extent to which the prosperity of New England is wrapped up in the cotton trade and industries subsidiary to it and dependent upon it.

It is no exaggeration to say that, directly and indirectly, by far the larger portion of our people get their living by cotton.

Thousands of mill operatives and their families rely absolutely upon the running of the machinery connected with the spinning and weaving of cotton.

Printers, bleachers, dyers, and innumerable other artisans deal with the gray cloth after it leaves the hands of the weavers; also to be taken into account are those engaged in the carrying trade and the coal trade.

Then again cotton finds employment for a great army of mechanics, machinery builders, and engine and boiler makers.

Repairs to the machinery are always proceeding, and renewals are continually going on, finding employment for thousands of other men.

Other considerable sections of the community dependent on cotton trade are the cotton dealers, and the merchants who dispose of the products of our spindles and looms, and many others with their offices and stores for the storage of cotton and cotton goods.

Add to all these the large number of trades people of various kinds who depend upon the custom of all these several groups of workers, and some realization can be formed of the vast numbers of the population who are vitally interested in this great staple trade.

It will thus readily be seen of what supreme importance the cotton trade is to the community at large; hence, again I repeat we have every reason to rejoice in the fact that we are at last emerging from the depression and stagnation from which the cotton industry of the country has suffered so long.

This improvement in trade, this revival of prosperity is of deep significance to the community as a whole.

In the firm belief that a clearer and more comprehensive understanding of the problems and difficulties surrounding the industry is desirable, permit me to suggest the seeming advisability of free and open discussion in these conventions of all matters affecting the welfare and the future of the industry, and to some of which matters I am about to invite your attention, as I have not hesitated to do on previous occasions when addressing you.

Let us hope that our investigations and our deliberations may result in action of such a beneficial and permanent character as will help remove the causes and the influences which oppress and demoralize the great trade in which we, all of us, are so vitally concerned.

The prosperity of New England is largely indebted to the

cotton industry and, like many another faithful servant, it is unfortunately to be feared that in not a few instances its well-being has been, if not ignored, at least misunderstood by some of those who have derived most advantage from it.

Let us, without fear or favor, as individual manufacturers, and as an influential and representative organization of manufacturers, endeavor to arouse a sentiment which will sweep away abuses and offenders with as little compunction as has been shown by those same offenders in relation to the welfare of the important interests with which they have been entrusted.

If these vast industrial interests are to be preserved to New England, it is, it seems to me, high time that the stockholders and the public in general took a more active and intelligent interest in their welfare and preservation.

It is not too much to say that the cotton industry is of national importance, and the country as a whole is deeply interested in its existence and in its prosperity.

Right or wrong it seems to be an accepted principle that reforms, whether national, local, political, or social, shall not be attempted unless those in authority are stimulated by pressure from without, the creation of a sound, healthy, and public sentiment being abnegated by those who ought to create and foster it; in the meantime, the public warfare, which constitutes the true wealth of communities, must not be allowed to suffer through the remissness, the inexcusable neglect, of self-satisfied or self-appointed officials.

Let those among us who have power, influence, or authority see to it that no effort be lacking on our part in ridding the industry of abuses detrimental to the interests of the industry in particular, and detrimental to the interests of the community in general.

Let us see to it that the cotton manufacturing industry of New England is managed and conducted on broad, sound, and equitable lines, thus enabling us to fight the battle of keen competion which now exists to a greater degree than ever before, and which, as time goes on, will become more and more intensified.

It may perhaps be recalled, gentlemen, that at our semi-annual meeting held in the White Mountains last fall I took occasion to draw particular attention to the unfortunate and unsatisfactory physical and financial condition of not a few of our New England mills.

I also very pointedly suggested the advisability, the necessity, of a radical change of both men and methods whenever conditions were in such bad shape as to call for reform and reorganization of a drastic character.

I have since discovered no reason for changing the views I then expressed and, whilst I desire to be temperate and courteous in what I do say, I consider no apology necessary, nor do I offer any for again referring to these same questions or matters; on the contrary, I do not hesitate to say right here and right now that, so long as we retain the power of speech, so long should our voices be raised and our protest heard against causes and abuses detrimental or harmful to the wellbeing of the industry, no matter where found, or by whom perpetrated, employer or employed.

As I have said on a previous occasion, where personal interests come into play there must be, even in men intending to be truthful and just, a great readiness to see facts which it is convenient to see and such reluctance to see opposite facts as will prevent much activity in looking for them.

Unbiased then by preconceived ideas, let us dispassionately endeavor to obtain some clear conception of what the situation actually is and of the nature of the conditions confronting the industry today.

First and foremost of all questions affecting all industrial enterprise is the question of industrial unity, industrial peace — the one great industrial problem engaging the attention of the thinking minds of the community, of the master minds of the civilized world.

Employers and employed, as all economists have shown conclusively, have common interests and no inherent antagonisms.

It is rightly affirmed that both are partners in the industry in

which they are engaged; neither have more than a life interest therein, and neither party is entitled to injure it by anything they may do or omit to do while it is in their possession.

After the experiences we have had in the past with strikes and lockouts, and in order to avoid useless and disastrous struggles in the future, it is imperative that there should be peace, contentment and industrial unity if the cotton trade is to live.

The more we regard this, the more the conviction grows that the promotion of permanent peaceful working in this great industry must not be jeopardized.

I repeat and repeat again the trade cannot afford strikes and lockouts; under such a system our competitors secure enormous advantages which they seize with marvellous energy.

Once the advantages are secured they are retained permanently, as the history of the trade clearly shows.

The vast difficulties of this question are not lost sight of but, in view of the progressive tendencies and wider knowledge of our time, it is hard to believe that the wit of man will fail to compass some solution of the problem.

We hopefully wait for some development of this nature in the confidence that the object lesson we have recently witnessed in the greatest cotton manufacturing centre in this country will not be without its effect in this direction.

Whatever helps to bring about such a result is well worthy every effort that may be put forth, and one in which every member of this Association, individually and collectively, should, in my judgment, take a lively interest and a leading part.

Whilst, personally, I am of the unalterable opinion — as I have stated elsewhere — that it is a policy, in every sense of the word, to pay to labor as liberal a return as circumstances permit of, and, further, whilst I am in favor of improving wherever and whenever possible the conditions under which the operatives have to work and live, it must not be forgotten that the mill management have to consider the paying of a dividend to the stockholders as much as the weekly wages of the operatives.

In other words, the wage earners are directly interested in the

stockholders — who find the capital to keep them employed — receiving a fair return on their investment, it being obvious that capital will not be attracted to unprofitable industries.

When capital is prosperous, labor is prosperous; when capital is prostrate, labor is prostrate; one cannot have good or bad fortune without the other.

Unless capital gets sufficient return and the money required for extending the scope of the industry is provided, the industry must inevitably languish.

It is perfectly plain that capital and labor are equally interested in the successful and harmonious working of all industry.

The common perils of the trade must be shared in common.

When trade is bad, both sides must make concessions; when trade is good, both sides should reap the benefit.

Personally, I am of the opinion, that the day has gone by when any small group of men on either side should be permitted, by a mere wave of the hand as it were, to stop the wheels of industry, demorallzing and paralyzing both the industry and the community.

I utterly fail to see by what right or title half a dozen individuals of either the manufacturing or the labor element should be permitted to arrogate to themselves, in this so-called enlightened age, such authority, such prerogative.

If the trade is to be profitably and successfully maintained, it is obvious and imperative that none but broad-minded and capable men with a thoroughly able appreciation of this great question should be permitted to regulate the course and direction of interests so far reaching.

If genuine progress is to be made we must pull together, not apart.

In this connection, however, we find on the one hand that certain manufacturers openly charge the operatives with obstructing progress by opposing the use of improved machinery, by resorting to agitation and strikes, with the object of forcing manufacturers to abandon the use of improved machinery or methods designed to improve the product and decrease the cost of production.

Such an attitude is absolutely unreasonable and untenable; it is suicidal and cannot be defended on any grounds of either expediency or common sense.

It will not be a mark of wisdom on the part of the operatives to decline the acceptance of what would benefit themselves and the industry upon which they are dependent for their daily bread.

It will not do to be content with things as they are; we must search for improvement in every direction so as to enable us to ride triumphantly over all difficulties, overcoming the obstacles which bar the way to all improvements.

We must be ever ready to apply new inventions to productive industry, satisfied that the best equipped industry and the most efficient business methods will reap their due reward.

Far better, in the best interests of all concerned, to have it understood clearly, distinctly, and once for all that the adoption of new machinery and devices must and will be uncompromisingly insisted upon.

This the manufacturers have positively stated, and are fully determined upon, and upon the insistance of which there can and must be no compromise no question whatsoever. It is vital.

We cannot but believe that, when once the operatives themselves are fully alive to the situation, they will show intelligence enough to acquiesce in the new and improved order of things.

It is imperative that they do so, and do so quickly, if the cotton industry of New England is not to go down in the struggle for supremacy.

Nothing can be more certain than that evolution in this particular will follow its course independent of all and every poposition.

We have no choice in the matter; progress is a necessity from which there is no escape, and from which there has never been any escape since the beginning of life.

The adoption of machinery designed to ensure the most economic and efficient system of production marks a wise and worthy attempt to place the industry on a firmer foundation than ever before.

It must not be overlooked that these inventions, I refer especially to the automatic loom and the warp motion, are open to others as well as ourselves, and not only may be equally shared in by them but may and are being utilized with effect against us in the keen competition and rivalry of today.

On the other hand, in connection with the introduction of improved machinery and new devices, it is asserted — and these things are openly stated in reputable daily papers and textile journals — that the operatives have grievances that are due to the heartlessness of the men who employ them; the actions of some of these men, we are told, have been simply low-lived, and, further, that there has been no exigency in the business entrusted to them by stockholders that warranted them in any degree in pursuing the course they have followed.

Further, it is said, the whole situation discloses a weakness in mill management that is making thoughtful stockholders heart-sick and weary of the mill business.

Aside from the great injury that has been done to the operatives, the industry as a whole, it is pointed out, has been injured in a way that may take months for reparation, the consequences going far beyond the few mills — the few mills, note you, gentlemen — that are notoriously wrong, and again, we are told, the injustices that have been practiced in some mills have aroused some managers to speak out against them because the good name of the industry is at stake.

Such a condition of affairs cannot but give rise to serious apprehension, and is calculated to do harm by instigating revolt.

Such conduct cannot be witnessed without indignant protest; conduct so unsound, so wanting in grasp of the situation, that it is hard to realize that such a state of affairs is possible.

The most serious reflection excited by such attitude is the importance of a closer and stricter supervision and regulation, if need be, by the directors and stockholders that shall hold to strict accountability the men who practice such methods.

The wrong committed should be amply and speedily rectified; the prosperity and the honor of the industry must be kept steadily in view, regardless of any other consideration.

It should not be forgotten that employers have obligations as well as privileges.

All power is a trust, and we are accountable for its exercise; no act of injustice can be perpetrated with impunity.

In connection with this matter, I trust I may, with all propriety, say that no man, be he whom he may, employer or employed, should be tolerated, who for any reason whatsoever ignorantly jeopardizes the welfare of New England's staple industry.

In so far as this sentiment goes, I do not believe any dissentient voice will be raised.

That by far the great majority of employers in their relations with the employed are actuated and influenced by sentiments of justice and fair dealing, there can be no question.

We refuse to believe otherwise.

I trust that what I have given expression to in this connection may not be wrongfully interpreted as wishing to engender an ill feeling between two bodies whose only strife should be as to which can do the greatest good for the common good of both, and for the common good of the industry and the community.

The first step towards obtaining any true grasp of all difficulties and problems must be to look fairly and bravely in the face the facts which lie behind them; it is worse than useless to ignore them.

There is a time to speak and a time to keep silent, and whilst I am desirous of not overstepping the possible limits of good taste or discretion, I must say it is amazing that the trade should be subject to such injury because of the unwisdom of a few men.

It has been well said that "capital and labor when deeply interested melt into each other"; there can be no question of the importance, the necessity, of industrial contentment, transcending as it does in interest and importance any other industrial problem, if not any other problem of the age.

There are, gentlemen, other subjects of much importance to the trade, one or two of which I will, with your indulgence,

briefly refer to, and which doubtless are engaging your individual attention, and which I venture to submit call for the collective consideration and wisdom of this Association.

In view of the unfortunate physical and financial predicament of some of our New England mills, it may not be inopportune at this particular time to emphasize how absolutely imperative it is to write off annually a sum amply liberal to adequately provide for the discarding of machinery which has been superseded or become practically obsolete long before it is worn out.

No dividend should be declared unless a certain amount for depreciation has been set aside, or unless the corporation has an ample reserve from which such dividend might safely be taken.

The wear and tear in the working of a mill is constant and great, and becomes a very serious item; it is necessary to make the proper allowance for it, which unless provided for is a gross miscalculation, and in time, as we see, is sure to be attended with disastrous consequences.

We all know that a working mill depreciates through the wear and tear of the machinery; an idle mill through rust, neglect, and actual decay; both depreciate by the progress of invention resulting in improvements that render the machinery valueless; the value of a mill never remains, neither when working or idle, and care should be taken to get the original capital back from it intact, before it is irretrievably lost.

Turning to another subject, — Dr. HENRY SMITH PRITCHETT, President of the Massachusetts Institute of Technology, in his address of welcome to this Association last year, said amongst other things, in speaking of the value and importance of technical training and instruction: "Either we shall lead in manufacture and lead in technical education, or we shall fall behind in manufacture and in technical education."

In this connection I need hardly remind you of the extent to which provision is made abroad for the supply of instruction of a technical and scientific character in aid of the industries of England, France, Germany, and other countries.

The great commercial and industrial progress of Germany,

which is perhaps more marked and pronounced than in any other country, is to be largely attributed, it is said, to the splendid industrial schools of that country.

In the firm belief of the industrial and commercial value of technical education, steady advance must be made by us in the further provision of facilities for higher scientific training as a means of developing our manufacturing industries, otherwise there can be no doubt that our supremacy in New England will be seriously challenged.

The textile school is unquestionably of singular value in training up a supply of well instructed young men capable, by reason of the methods employed in these schools, to take the lead as overseers and superintendents in our manufacturing establishments, adding to their equipment for the practical work of the mill.

The time is upon us when we must exchange the work of our hands and the thought of our brains with those of other countries.

We enrich ourselves in the degree in which our knowledge and work are equal or superior to that of others.

Technical and scientific training is one of the great hopes upon which the cotton manufacturing industry of New England must depend for the continuance of its prosperous existence.

A word with respect to the treatment of cotton mill properties by our legislators and tax gathers: — in frequent instances our cotton mills have suffered severely from excessive taxation under circumstances where it would be expected that any deviation from the strict letter of the law would be exercised on the side of leniency.

The establishment of any large industry in a town may be due to natural water supply, freight facilites, or favorable atmospheric conditions, and this in turn has brought into the town a large amount of property which would not otherwise be there, and this, with the tributary industries which have sprung up in connection with the homes and living of the large population, has brought prosperity to locations which would otherwise be sterile farming districts or perhaps a few fishing hamlets.

The residents of some towns, in the exercise of the rights of numerical majorities, have entered upon public expenditures to an extent which would not be contemplated with an equivalent population except in connection with such large concentrations of non-resident property.

The excessive valuations have been so onerous that long and expensive litigation in the higher courts has been necessary to establish the equities in the matter.

It is this appraisal to an excess above market values which has imposed a serious impediment upon manufacturing in locations where it should, in all justice, have received every welcome and all the encouragement which could be offered to any enterprise bringing to such a community wide spread conditions of prosperity.

Oftentimes, the corporations receive very little direct benefit from the money raised by taxation of which they pay a very large share.

There is little or no justification for deriving revenue from a particular class of property, or kind of business, merely because it is believed that it can be easily done; the effect upon the business subjected to the exaction is vexatious and oppressive; undue or excessive taxation has a detrimental effect upon the industry; unjust and unjustifiable taxation is, to say the least of it, unbusinesslike and inexpedient, the business being unable to bear too heavy a burden of this kind without serious injury.

I take it as incontrovertable that the group of states known as the New England states, in all matters affecting these states, intend and are determined that they shall lead, not follow; that they shall continue to be the pioneer states of the Union in everything that goes to make for progress, advancement, and prosperity; in everything that helps forward the cause of humanity; in everything pertaining to the common good and well being of all alike in these same states.

We ask and desire, as I understand it, no advantage in any particular over any of our sister states, nor do we, I feel confident, desire any legislation of a retrograde nature.

On the other hand, however, and in all reason, equity, and common sense, as a simple business proposition, we do and must respectfully ask and insist that our legislators do not unduly and unfairly handicap us and cripple our industries by imposing upon us such severely restrictive laws that we cannot longer compete with other states with any degree of legitimate profit or success.

We must as a matter of simple self-preservation make haste slowly, or at least conservatively in this direction; we must not forge too far in advance of our neighbors and competitors to our own detriment.

There is a point, a limit, beyond which it is unwise and inexpedient to go in the matter of restrictive legislation in these days of keen and growing competition with each other and within our own borders.

Note the solid and masterful advance of the manufacture of cotton in the Southern States in face of the established industry in the North; the successful establishment of the industry in the South in such magnitude is not a temporary situation, it is a permanent and meaningful fact, and is of especial practical concern to New England, making itself felt very effectively, aggressively competing with us for business and getting it.

Too oppressive laws will inevitably result in stimulating the growth and development of all industry beyond the jurisdiction of the states imposing the same.

Opposition to unduly restrictive legislation should by argument and information be as vigorous, forcible, and effective as circumstances demand.

One more reflection, gentlemen, and I conclude: It is evident that we have reached a period in the history of the cotton manufacturing industry of New England, a point where it has become more than ever necessary to exercise the strictest economy and the highest degree of efficiency in every detail, in every particular; where the peaceful and orderly development of the industry must be assured; where we must ask ourselves the question, what have we done, what are we doing, what have we

achieved; where we must dispense with the men who have done everything they ought not to have done, and who have done nothing that they ought to have done; where the qualities necessary for the welfare of the industry are great mental energy, enterprise, powers of prolonged application, and a sense of simple minded and single minded devotion to duty, a pursuit which steadily continued will obtain for it the approbation of all honest and honorable minds.

Despite the complexity of the problems encountered, despite the complex rivalry and competion encountered, a rivalry keener, a stress severer, a pace quicker than ever before; ceaseless progress on the one hand, ceaseless stress and competition on the other; despite all this, I say, we do not understand the verb "to fail" nor are we acquainted with the word "impossible"; the free utilization of the powers of the best men in the places for which they are best fitted; the free utilization of such men in the fullest degree, in the management and direction of the industry, in the direction of invention and of improvement, the cotton manufacturing industry of New England will not suffer; it will develop in magnitude, importance, and prosperity that will make it, as time goes on, pre-eminent in the cotton world, that will make it one of the great factors, one of the most potent factors in the life and the industrial development of this great country.

Gentlemen: In view of the fact that we are, as a nation, entering the first phase of a new world-wide commercial struggle; in view of the increasing and complex rivalry encountered on every hand; in view of the immensity of the interests dependent for their prosperity on the cotton manufacturing industry, the fate of this industry is not and cannot be indifferent to any of us. We are jointly proud in the consciousness of being responsible for its well-being, and answerable for its future. The one grand object of our contemplation must ever be to safeguard its honor and to see to it that its future be assured, in so far as human effort and foresight can devise and determine. This, I take it, is the legitimate aim and aspiration of the New England Cotton Manufacturers' Association.

PRESENTATION OF TESTIMONIAL TO THE SECRETARY.

Before we proceed further with the regular business of the meeting I have a most pleasing duty to perform in the presentation I am about to make on behalf of the New England Cotton Manufacturers' Association to our Secretary and Treasurer, Mr. C. J. H. WOODBURY.

As you may be aware, it has for some time past been felt that some fitting recognition should be made of Mr. WOODBURY'S faithful work during the ten years he has held the office of Secretary and Treasurer of this Association. Hence this testimonial, and I feel myself favored, in that it has fallen upon me to be the mouthpiece of the Association upon this occasion.

The committee having this matter in charge, consisting of Mr. JAMES R. MACCOLL, chairman, Mr. GEORGE A. AYER and Mr. C. P. BROOKS, who acted as secretary and treasurer, after full consideration decided to purchase as a fitting testimonial to the Secretary, this hall clock, and this bronze statue with our compliments to Mrs. WOODBURY and which it is hoped will meet with your approval.

The members who have contributed to this testimonial have not only shown their appreciation of the movement by their generous contributions, but by many letters which they have sent, warmly commending the services of Mr. WOODBURY.

It affords me, sir, (addressing Mr. WOODBURY) very unusual pleasure to present to you on behalf and in the name of the New England Cotton Manufacturers' Association this evidence of their esteem and regard — this token of their appreciation of your invaluable services. My only regret is that my poor words so ill convey, so poorly express the kindly, generous and appreciative sentiments of the members toward you, and it is earnestly to be hoped that this Association may for many years to come derive the benefit of your great interest in its welfare, which sentiment is held by every one of the eight hundred members of this Association. [Applause].

Mr. C. J. H. WOODBURY, Secretary. Mr. President and gentlemen, fellow members of the Association: It appears that it is time for me to concede the truth of the story which has been related in connection with myself when the Association was at Charlotte, North Carolina, but which I have always denied, like a Peter, to the effect that when I was going down stairs, leaving the club for the station, some one reminded me that I didn't have my hat, and I disdainfully refused it, stating that it would not fit if I did have it, — only we must change the locus of the incident from Charlotte to Boston and the time to the present.

A short time ago when the committee of the Board of Government informed me what they had done, I confess that I had a feeling that it was beyond anything that I deserved; that you are the Association — you have made it — it required on my part a touch here, and perhaps a restraint there, to bring out from you your own resources enough to make this organization not merely the only technical textile organization of its kind, but to bring its standard up to the high rank which has rendered it universally respected.

The growth of this Association has been marvellous. The logic of figures show that the membership has increased a little over three times in the last ten years; the pages of Transactions have multiplied five times; the income has augmented six times, and the cost per page of Transactions to the members has diminished to thirty per cent. of what it was two years ago. That, of course, would be inevitable with the larger editions.

But greater than any increase in numbers or in funds, there has been the more valuable growth of confidence and the extension of a beneficent influence in the purposes of this organization.

Since I have been Secretary there has not been an international exhibition in which the Federal Government took a part that this Association has not been consulted by the administration of the Federal Government, and its advice followed, in regard to the methods to be used in the exhibit of American

textile manufactures at the various American and foreign expositions.

This work of the Association through its Board of Government, has been so thoroughly and fully carried out that I cannot claim that there was anything left for the Secretary to do, except to design your badge pins twice a year.

We have had also the co-operation of the press. I think that I have had as much reason as anybody has had to complain of the press, as such is the fashion, but the nature of my complaint has not been in the usual line, it has been their exasperating accuracy, and therefore it has been necessary for all of the advance papers and the Transactions to be presented in the most perfect manner. These advance papers have been prefaced with a paragraph asking the press not to publish them ahead of their reading. This has enabled the authors to have full and correct reports on technical subjects to an extent which I do not believe has been vouchsafed to any organization in this country. It would be impossible for anyone to correctly report such papers in the reading; and yet there has never been a single instance on the part of the press of the violation of the confidence which has been reposed in them by freely giving them the advance copies. Eight thousand copies have been printed for this meeting.

But I will not detain you longer. You know what your Association is. The Board of Government require that each and every detail of its affairs shall be presented to the members, not only in the reports published, but in individual communications, or by the circulars sent to the members.

Now, gentlemen, I thank you very much, not only for this beautiful testimonial which will pleasantly while away the time, but also for the heritage of good will which accompanies it; and on the part of Mrs. WOODBURY I give you similar thanks. [Applause].

AWARD OF ASSOCIATION MEDAL.

The SECRETARY. The committee on the award of the Association medal have submitted this report:

Your committee have carefully examined the papers read before the New England Cotton Manufacturers' Association at the April and October meetings of the year 1904, and have also briefly considered the field of invention to date. Nearly all the papers for the year 1904 are of great merit, and we are sure compare favorably with any of those presented in former years.

We are of the opinion that the paper of Mr. HENRY G. KITTREDGE of Boston, upon the Economic Extension of Cotton Cultivation in the South, volume 77, page 121, treats in a very able manner a subject of the broadest and most vital interests to the cotton manufacturers of the United States, and this has also been considered in connection with former papers by the same author, upon the Cotton Fibre in Some of Its Phases, and the Supply of Cotton for Fine Spinning; and he is, therefore, entitled to the Association Medal for 1905 for these contributions upon cotton culture.

Respectfully submitted,

S. A. KNIGHT, *Chairman.*
W. E. PARKER,
ROBERT McARTHUR,
D. M. THOMPSON.
Committee.

BOSTON, April 10, 1905.

Mr. S. A. KNIGHT. Dear and Honored Sir (addressing Mr. KITTREDGE), I trust I voice the sentiments of the entire Association when I express my warm appreciation of the services that you have performed heretofore.

I, therefore, take great pleasure in presenting to you this beautiful Association Medal as a token of our estimate of the very valuable service you have rendered.

Mr. HENRY G. KITTREDGE. Mr. Chairman, I shall always esteem and honor the significance of this token, and the Asso-

ciation's appreciation of my services. And I sincerely thank you for the kind and graceful words in which you have presented it. [Applause.]

The PRESIDENT. The next business, gentlemen, is the reading of the reports of the Secretary and Treasurer.

THE SECRETARY'S REPORT.

The past year has been one of great moment of the Association which has been the natural result of increase in members and also the unprecedented size of its Transactions which has exceeded that of any former year.

The Board of Government have held six meetings and kept closely in touch with the varied matters pertaining to the Association which came up for their consideration.

ASSOCIATION MEDAL.

The fourth Association medal last year was awarded to DANIEL MOORE BATES of Wilmington, Delaware, for his papers on Gray Goods for White Lawn Work, volume 74, page 235; and Waxes in Warp Sizing, volume 75, page 147, of the Transactions; being, as in the case of former medals, also based upon previous contributions* by the recipient, the committee being Messrs. CHARLES H. FISH, WILLIAM D. HARTSHORNE and SIDNEY B. PAINE.

The Board of Government appointed Messrs. STEPHEN A. KNIGHT, WALTER E. PARKER, D. M. THOMPSON and ROBERT MCARTHUR a committee to recommend the award for the Association medal for this year and the decision of the committee will be made at this meeting.

THE STUDENTS' MEDAL.

The students' medal has been awarded to the following members of graduating classes of textile schools designated by the

* Gray Goods from the Bleacher's and Finisher's Point of View, volume 66, page 226; Cotton Export Trade with China, volume 69, page 309.

Board of Government, the awards in each case being made to the pupil of the highest rank as determined by committees of members of the Association:

FRED TAYLOR, New Bedford, Mass., a graduate of the New Bedford Textile School, New Bedford, Mass.

WILLIAM RANSOM MEADOWS, Lowell, Mass., a graduate of the Lowell Textile School.

JOSEPH ETHELDRED MOORE, Plains, Ga., a graduate of the Georgia School of Technology.

ABRAHAM A. LEVY, New York City, a graduate of the Philadelphia Textile School.

LIFE MEMBERSHIP.

During the past year, the Association adopted the following amendment to the Constitution for life membership.

"ARTICLE 5. Any active or associate member by the single payment of one hundred dollars shall be exempt from all future payments for dues and shall become a life member having all the privileges of active members.

All moneys thus paid shall be invested as a permanent fund by the Treasurer acting under the direction of the Board of Goverment, of which the income only shall be subject to appropriation for current expenses."

At the time of the preparation of this report, seven members have qualified for life membership under the provisions of this article, namely:

CHARLES H. FISH, JOHN R. MITCHELL, ROBERT W. NEFF, WALTER E. PARKER, GEORGE I. ROCKWOOD, ROBERT SCHAELLIBAUM and C. J. H. WOODBURY.

AMENDMENT TO THE CONSTITUTION.

The Board of Government has been advised by counsel that the present by-laws do not contain any provision for completing the organization of the Board under conditions of members failing to accept elections to office. To remedy this defect for the future, the following amendment, of which due notice was given

at the seventy-seventh meeting and also in the call to this meeting, will be presented with the approval of the Board of Government.

The provisions of this amendment, if adopted, will not be retroactive but will apply only to those elected after its passage.

Amend Article 8 by adding the words: "Unless sooner removed as hereinafter provided."

Article 10 by inserting after the words "resignation" in the eleventh line of said article the words "or removal."

Insert after the word "meeting" in line thirteen of Article 10 the words: "except as hereinafter provided."

Insert new section as follows:

"Any officer who shall unreasonably absent himself from three consecutive meetings of the Board of Government of which he is a member, or shall otherwise neglect or refuse to perform the duties of his office, may be removed from office at any regular meeting of the Board of Government by a vote of a majority of the members present and voting thereon, a notice of such proposed action to be sent to him by mail at least one week previous to the meeting."

Two-thirds of the members present and voting thereon must vote in the affirmative in order to adopt the foregoing proposals.

THE WEEKS BEQUEST.

The circumstances connected with the payment of the bequest of GEORGE W. WEEKS to this Association were of such great importance in defining its status as an organization and will no doubt bear in a very important measure on any future gifts or bequests that it is considered best to present the facts of the case as a record for the Transactions.

The executors under the will of GEORGE W. WEEKS, late of Clinton, Mass., sent to the Association a check for $950.00 and interest as payment of the legacy of $1,000, $50 being deducted for the collateral legacy tax of the Commonwealth of Massachusetts.

Your Treasurer declined to give a probate receipt releasing the estate and executors from further liability under the will, and reported the same to the Board of Government at its meeting April 28, 1904; and by vote the treasurer was authorized to "take such means as may be necessary by appearance before the Probate Court at Worcester or by other means to obtain the relief from paying the inheritance tax on the bequest on the grounds that it comes under chapter 12, section 5 of the statutes of the Commonwealth of Massachusetts as being a literary, benevolent and scientific institution."

The State Treasurer ruled that the tax was valid against the Association and the Attorney-General gave his opinion against the Association. Our counsel requested the executors to bring a petition in equity for the determination of the matter, which they declined to do and the Association brought suit against the executors of the estate for the amount of $50 before the Probate Court at Worcester.

At the hearing, your Secretary and Treasurer appeared and gave testimony on the subject of the Association and its methods, introducing as exhibits Transactions, medals, Treasurer's Reports and volumes of Transactions in which attention was called to certain information bearing upon the subject at issue.

The Judge decreed that this action was not brought in proper form and dismissed the case without prejudice and ordered the executors to bring a petition in equity in the identical manner as first requested by our counsel; and upon this second action without rehearing the testimony, he gave the following decision on July 19, sustaining the contention of the Association:

COMMONWEALTH OF MASSACHUSETTS.

WORCESTER, ss.

At a Probate Court holden at Worcester in and for the said county of Worcester, on the nineteenth day of July, in the year of our Lord nineteen hundred and four.

On the petition in equity of GEORGE P. TAYLOR and JONATHAN SMITH, executors of the will of GEORGE W. WEEKS, late of Clinton, in said county, deceased, Petitioners against the New England Cotton Manufacturers'

Association, and EDWARD S. BRADFORD, Treasurer of the Commonwealth, Respondents praying said Court to determine whether a certain legacy bequeathed by the will of said deceased to the New England Cotton Manufacturers' Association is subject to a collateral legacy tax. All persons interested having waived notice and having answered to said petition and after due hearing and consideration, the Court doth decree that the legacy of one thousand dollars bequeathed by said will to the New England Cotton Manufacturers' Association is not subject to collateral legacy tax under the provisions of the Revised Laws, Chapter 15, and amendments thereto.

(Signed) WILLIAM T. FORBES,
Judge of Probate Court.

During the year, the following members have died: WILLIAM J. CRAY, PHILIP H. FOWLER, GEORGE E. KENT, JOHN KILBURN, HENRY G. MCCARTER, JOSEPH S. TIDD, JOHN A. WALSH and GEORGE W. STAFFORD, biographical sketches of whom will appear in the volumes of Transactions for the year.

MEMBERSHIP.

At the beginning of the fiscal year, the total membership was 703 which has been increased by the election of 66 at the two meetings. This number has been diminished by 25 resignations and eight deaths and two who failed to confirm their elections and fifteen dropped for non-payment of dues, leaving the net membership at this meeting including the election of 36 candidates already proposed, 755.

The following table shows the membership of the Association at various meetings since its foundation in April, 1865, the number elected and the number of present members:

MEMBERSHIP OF THE ASSOCIATION.

Number of Meeting.	DATE OF MEETING.	Membership.	Number of Present Members	Number Elected to Membership.
1	Apr. 20, 1865, Boston, Mass.	44	5	44
	July 19, 1865, Adj. Meeting,	—	3	42
2	July 18, 1866, Boston, Mass.	72	0	0
3	July 17, 1867, " "	—	1	10
4	Jan. 15, 1868, " "	108	0	32
5	July 15, 1868, " "	—	1	12
	Oct. 21, 1868, Adj. Meeting,	—	2	6
6	Apr. 21, 1869, Boston, Mass.	—	1	19
7	Oct. 20, 1869, " "	—	1	8
8	Apr. 20, 1870, " "	144	0	12
9	Oct. 19, 1870, " "	—	0	5
10	Apr. 19, 1871, " "	—	1	9
11	Oct. 18, 1871, " "	—	1	16
12	Apr. 17, 1872, " "	166	4	29
13	Oct. 16, 1872, " "	—	3	14
14	Apr. 16, 1873, " "	175	1	13
15	Oct. 15, 1873, " "	—	4	17
16	Apr. 15, 1874, " "	189	1	13
17	Oct. 21, 1874, " "	—	0	7
18	Apr. 21, 1875, " "	199	1	13
19	Oct. 27, 1875, " "	—	2	18
20	Apr. 26, 1876, " "	200	1	11
21	Oct. 25, 1876, " "	—	1	13
22	Apr. 25, 1877, " "	213	4	20
23	Oct. 31, 1877, " "	—	2	9
24	Apr. 24, 1878, " "	210	5	8
25	Oct. 30. 1878, " "	—	1	11
26	Apr. 30, 1879, " "	205	3	10
27	Oct. 29, 1879, " "	—	5	16
28	Apr. 28, 1880, " "	219	2	14
29	Oct. 27, 1880, " "	—	3	13
30	Apr. 27, 1881, " "	231	2	11
31	Nov. 30, 1881, " "	—	1	6
32	Apr. 26, 1882, " "	231	2	9
33	Oct. 25, 1882, " "	—	2	5
34	Apr. 25, 1883, " "	240	4	15
35	Oct. 31, 1883. " "	—	3	10
36	Apr. 30, 1884, " "	247	4	9
37	Oct. 29, 1884, " "	—	2	2
38	Apr. 29, 1885, " "	225	3	3
39	Oct. 28, 1885, " "	—	5	8
40	Apr. 28, 1886, " "	225	4	7
41	Oct. 27, 1886, " "	—	5	8

Number of Meeting.	DATE OF MEETING.	Membership.	Number of Present Members	Number Elected & Membership
42	Apr. 27, 1887, Boston, Mass.	234	4	10
43	Oct. 27, 1887, " "	——	2	3
44	Apr. 25, 1888, " "	241	10	15
45	Oct. 31, 1888, " "	——	6	12
46	Apr. 24, 1889, " "	242	3	6
47	Oct. 30, 1889, " "	——	4	8
48	Apr. 30, 1890, " "	246	4	7
49	Oct. 29, 1890, " "	——	6	11
50	Apr. 29, 1891, " "	254	2	4
51	Oct. 28, 1891, " "	——	5	8
52	Apr. 27, 1892, " "	244	9	12
53	Oct. 26, 1892, " "	——	13	19
54	Apr. 26, 1893, " "	259	4	11
55	Oct. 25, 1893, " "	——	6	9
56	Apr. 25, 1894, " "	270	11	16
57	Sept. 27—28, 1894, Crawford House, N. H.	292	12	19
58	Apr. 24—25, 1895, Providence, R. I.	383	62	92
59	Oct. 24—25, 1895, Atlanta, Ga.	422	30	46
60	Apr. 29—30, 1896, Boston, Mass.	450	20	29
61	Sept. 22—24, 1896, Profile House, N. H.	459	14	19
62	Apr. 28—29, 1897, Boston, Mass.	495	31	43
63	Oct. 27—28, 1897, Philadelphia, Pa.	523	23	38
64	Apr. 27—28, 1898, Boston, Mass.	535	17	24
65	Sept. 27—29, 1898, Crawford House, N. H.	554	9	16
66	Apr. 26—27, 1899, Boston, Mass.	564	25	33
67	Oct. 5— 6, 1899, Montreal, P. Q.	580	16	22
68	Apr. 25—26, 1900, Boston, Mass.	603	29	38
69	Oct. 16—18, 1900, Washington, D. C.	628	26	38
70	Apr. 24—25, 1901, Boston, Mass.	647	27	33
71	Sept. 25—26, 1901, Niagara Falls, N. Y.	661	15	19
72	Apr. 23—24, 1902, Boston, Mass.	681	36	42
73	Sept. 30—Oct. 2, 1902, New York, N. Y.	699	19	24
74	Apr. 22—23, 1903, Boston, Mass.	706	38	41
75	Sept. 29—Oct. 1, 1903, Lenox, Mass.	723	26	27
76	Apr. 27—28, 1904, Boston, Mass.	744	35	41
77	Sept. 21–22, 1904, Bretton Woods, N. H.	761	24	25
78	Apr. 26–27, 1905, Boston, Mass.	755	36	36

The headquarters of the Association have been well patronized by members during the year and the bound volumes of the Transactions and also the books of reference and technical papers have been frequently consulted by those without the Association as well as by its members. The rooms have been called into

frequent use by members for various business conferences during the year.

As the office copies of the Transactions of the Association were destroyed by fire February 2, 1890, there is a demand for copies earlier than that date, particularly on the part of the libraries of technical institutions, and the Secretary would like information of any earlier copies which may be for sale.

There is one complete set on sale of which further particulars may be obtained of the Secretary.

The Transactions of the following societies and periodicals are sent to the Association and kept on file.

TRANSACTIONS OF TECHNICAL SOCIETIES.

American Society of Civil Engineers,	New York.
American Society of Mech. Engineers,	New York.
American Institute of Elect. Engineers,	New York.
Boston Chamber of Commerce,	Boston.
Consular Reports, Bureau of Statistics,	Washington, D. C.
Japan Cotton Spinners' Association,	Osaka, Japan.
National Association of Wool M'frs.,	Boston.
National Electric Light Ass'n,	New York.
Western Society of Civil Engineers,	Chicago.

LIST OF PERIODICALS KEPT ON FILE.

American Cotton Manufacturer,	Charlotte, N. C.
American Industries,	New York, N. Y.
American Wool and Cotton Reporter,	Boston.
Boston Journal of Commerce,	Boston.
Cassier's Magazine,	New York.
Cotton,	Atlanta.
Cotton,	Manchester, Eng.
Dry Goods Economist,	New York.
Dun's Review,	New York.
Dun's Review, International Edition,	New York.
Engineer,	Chicago.
Engineering Record,	New York.
Fibre and Fabric,	Boston.
Freight,	New York.

Iron Age,	New York.
Lowell Textile Journal,	Lowell.
Machinery,	New York.
Manufacturers' Record,	Baltimore.
Mill and Shop,	Boston.
New England Shoe and Leather Association Monthly Gazette,	Boston.
New York Commercial,	New York.
Power,	New York.
Practical Engineer,	Philadelphia.
Protectionist,	Boston.
Technical World,	Chicago.
Textile American,	Boston.
Textile Manufacturers' Journal,	New York.
Textile Recorder,	Manchester, Eng.
Textile World Record,	Boston.

Respectfully submitted,

C. J. H. WOODBURY,
Secretary.

April 26, 1905.

TREASURER'S REPORT.

C. J. H. WOODBURY, TREASURER IN ACCOUNT WITH THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

April 1, 1904 to April 1, 1905.

DEBTORS.

Cash,	$287 87	
Life membership,	300 00	
Active membership,	2,909 86	
Associate membership,	1,420 23	
Active admission fees,	380 00	
Associate admission fees,	450 00	
Interest,	146 37	
Sale of Transactions,	281 50	
Engraving,	30 30	
Miscellaneous,	15	
Postage, telegrams and express,	6 90	
Advertising,	1,155 00	
Executors of Estate of George W. Weeks,	1,000 00	
Drew from Savings Bank for Investment,	437 11	
Loan,	500 00	
		$9,305 29

CREDITORS.

Interest,	$4 08	
Sale of Transactions,	40 00	
Board of Government,	187 90	
Amount forward,		$231 98

Amount forward,	$231 98	
Office rent,	399 96	
Secretary and Treasurer,	2,000 04	
Reports of meetings,	108 80	
Notices and Stationery,	254 53	
Meeting expenses,	134 76	
Printing and distributing Transactions,	2,293 76	
Engraving,	122 28	
Badges,	36 10	
Life Membership Fund deposit in Savings Bank,	100 00	
Miscellaneous,	31 33	
Postage, telegrams and express,	148 58	
Advance copies of papers,	233 15	
Office supplies and furniture,	9 27	
Stenographer and proof,	745 83	
Medal and Certificate Fund,	46 67	
Investment of Association Funds in bonds,	1,935 11	
Cash,	473 14	
		$9,305 29

The Association now holds the following funds for the specific purposes as set forth, and the income during the past fiscal year is as follows:

	Principal.	Income.
Association Medal and Certificate Fund,	$1,000 00	$57 20
Students' Medal Fund (Donation of Moses Pierce)	200 00	11 44
Library Fund (Bequest of George W. Weeks)	1,000 00	52 43
Life Membership Fund,	600 00	25 30
	$2,800 00	$146 37

Invested as follows:

Bonds,	$1,935 11
Savings Bank,	864 89
	$2,800 00
Textile Scholarship Fund (Donation of Wm. Firth),	3,000 00

The principal of this fund is held in trust by the Treasurer of the New Bedford Textile School and the income sustains the scholarship in accordance with the provisions of the deed of trust executed by this Association and the New Bedford Textile School, February 20, 1902.

AUDITOR'S REPORT.

I hereby certify that the amounts from April 1, 1904, to April 1, 1905, are correctly cast, that all payments are properly vouched for, that the funds are kept in deposit in the name of the New England Cotton Manufacturers' Association, and that the amount of the deposit April 1, 1905, agrees with the balance in the books, viz., $473.14.

The securities in which the Association funds have been invested have been examined.

C. F. ROBERTS,
Auditor.

BOSTON, MASS., APRIL 7, 1905.

The earnings of the Association for the year may be placed as:

3 Life memberships at $100,	$300 00	
586 Active dues at $5,	2,930 00	
167 Associate dues at $10,	1,670 00	
43 Active admission at $10,	430 00	
23 Associate admissions at $25,	575 00	
Advertising,	$1,271 67	
Miscellaneous,	465 22	
		$7,641 89

The disbursements of the year amount to $6,797.04, which is $844.85 less than the earned income.

For the first time, the Association has been obliged to obtain a loan on account of deferred payment of dues. This loan was paid shortly after the end of the fiscal year, but it is submitted that the Association ought not to have been obliged to make such a loan because the amount due the Association at that time was over four times the amount needed.

Bills receivable:

Active dues and admission,	$340 00	
Associate dues and admission,	670 00	
Advertising,	450 00	
		$1,460 00

There are no bills payable, except the loan which has been paid at the time of the presentation of this report.

The income derived from advertisements has enabled the Association to be conducted on the same basis as other technical organizations which are supported by higher assessments as well as by advertisements in their transactions. The receipts from this source have amounted in the several volumes of the Transactions to:

63	Philadelphia, October, 1897,	$385 00
64	Boston, April, 1898,	420 00
65	Crawford House, September, 1898,	450 00
66	Boston, April, 1899,	550 00
67	Montreal, October, 1899,	445 00
68	Boston, April, 1900,	580 00
69	Washington, October, 1900,	665 00
70	Boston, April, 1901,	620 00
71	Pan-American, September, 1901,	595 00
72	Boston, April, 1902,	575 00
73	New York, September — October, 1902,	645 00
74	Boston, April, 1903,	745 00
75	Lenox, September — October, 1903,	705 00
76	Boston, April, 1904,	616 00
77	Bretton Woods, September, 1904,	650 00
78	Boston, April, 1905,	460 00

The following table presents the finances of the Association for the past fourteen years. It will be noted that the cost of maintaining the work of this Association on the unit of the cost per page of the Transactions for each member is less than that of recent years:

MEMBERSHIP.			TRANSACTIONS.			FINANCES.				
Fiscal Year Ending April 1.	Enrollment.	Members Elected.	Volume Number.	Pages in Volume.	Pages for Year.	Cash Receipts.	Expenses.	Cost per Page of Transactions.	Cost per Member.	Cost per Page of Transactions for each member Cents.
1891	246	18	48 49	43 62	105	$1,142 00	$ 926 08	$8 82	$3 76	3.59
1892	254	12	50 51	129 60	189	1,260 68	1,374 46	7 27	5 41	2.86
1893	244	31	52 53	63 94	157	1,678 33	1,603 25	12 22	6 57	6.33
1894	259	19	54 55	84 86	170	1,414 58	1,807 60	10 63	7 03	4.14
1895	270 292	35	56 57	73 230	303	1,947 07	1,957 64	6 46	6 71	2.21
1896	384 422	142	58 59	310 327	637	4,579 19	3,636 31	5 71	8 59	1.34
1897	450 459	49	60 61	269 359	628	3,710 02	3,980 34	6 33	8 67	1.43
1898	495 523	83	62 63	353 453	806	4,717 08	4,333 85	5 38	8 28	1.18
1899	535 554	42	64 65	321 380	701	4,713 56	4,775 97	6 81	8 62	1.23
1900	564 580	56	66 67	464 296	760	5,237 53	5,007 23	6 57	8 63	1.14
1901	603 628	78	68 69	382 476	858	6,331 93	6,295 55	7 34	10 02	1.16
1902	647 661	52	70 71	366 379	745	6,724 23	6,035 84	8 10	9 13	1.22
1903	681 699	66	72 73	342 415	757	6,768 81	6,701 65	8 85	9 58	1.26
1904	706 723	68	74 75	512 374	886	6,794 50	6,848 75	7 73	9 47	1.07
1905	744 761	66	76 77	376 313	689	7,080 31	6,797 04	9 86	8 93	1.29

April 26, 1905.

Respectfully submitted,

C. J. H. WOODBURY,

Treasurer.

AMENDMENT TO CONSTITUTION.

The SECRETARY. By approval of the Board of Government this ballot is submitted for an amendment to the constitution and by-laws, of which notice was given at the Bretton Woods meeting, by Mr. WILLIAM D. HARTSHORNE. In answer to a question I would state that at the time of the litigation upon the taxation under the collateral legacy tax in connection with the WEEKS' Bequest to the Association, that the counsel of this Association found on examination that there was a legal defect of omission in the constitution and by-laws of the Association, in that they did not contain adequate provisions for the Board of Government to maintain its numbers in active service under all conditions, while the members as such have authority for preserving the integrity of the membership.

BALLOT FOR AMENDMENT TO CONSTITUTION AND BY-LAWS.

In accordance with the notice given at the 77th meeting the following amendment is submitted with the approval of the Board of Government in accordance with Article 5 of the Constitution and By-Laws, namely, —

Amend Article 8 by adding the words: "Unless sooner removed as hereinafter provided."

Amend Article 10 by inserting after the words "resignation" in the eleventh line of said article the words: "or removal."

Insert after the word "meeting" in line thirteen of Article 10 the words: "except as hereinafter provided."

Insert new section as follows:

"Any officer who shall unreasonably absent himself from three consecutive meetings of the Board of Government of which he is a member, or shall otherwise neglect or refuse to perform the duties of his office, may be removed from office at any regular meeting of the Board of Government by a vote of a majority of the members present and voting thereon, a notice of such proposed action to be sent to him by mail at least one week previous to the meeting."

Two-thirds of the members present and voting thereon must vote in the affirmative in order to adopt the foregoing proposals.

In accordance with the Constitution and By-Laws, the above will require the assent of two-thirds of the members present and voting thereon for its adoption.

Write Yes or No,.....

Name of person voting......

The PRESIDENT. The chair will appoint a committee of three to collect and count the ballots, Mr. C. W. DENNETT, Mr. E. A. THISSELL and Mr. DANIEL MOORE BATES.

The committee proceeded to the discharge of their duties, and subsequently reported the result of the vote as follows:

Total number of votes,		46
Yes,	43	
No,	1	
Blanks,	2	

The President thereupon declared the amendment adopted.

The following papers were read:

New Classification of Color.
A. H. MUNSELL, Boston, Mass.

Discussed by WILLIAM D. HARTSHORNE and CHARLES W. DENNETT.

STATIC ELECTRICITY NEUTRALIZED.
PHILIP DANA, Westbrook, Maine.

The SECRETARY. I have received a letter from Mr. C. B. BYRANT, secretary and treasurer of the American Cotton Manufacturers' Association, extending the best wishes for a happy and successful meeting, and taking the opportunity to extend a cordial invitation to you, the members of the New England

Cotton Manufacturers' Association, to attend their ninth annual meeting at Knoxville, Tennessee, May 10th and 11th.

In connection with this I would state that there has been an arrangement made for special trains and privileges on a train from Boston that will cover the round trip for $48.75. Detailed schedules are on the table in the entry, or information can be gained from Mr. DANIELS and Mr. GAITHER, who are in the hall.

SECOND SESSION.

WEDNESDAY AFTERNOON, APRIL 26, 1905.

Meeting called to order at 2.00 P. M., President WALMSLEY in the chair.

The following papers were read:

The Relationship between the Planter and the Manufacturer: Its Unnecessary Antagonisms.
THEODORE H. PRICE, 82 Beaver street, New York City.

Gray Goods for Clay Filled Work.
DANIEL MOORE BATES, Wilmington, Del.

Experiments in the Manufacture of Cotton Yarn.
STEPHEN E. SMITH, Lowell, Mass.

Mill Ventilation and Its Influences.
EBEN C. WILLEY, Hope Mills, N. C.

THIRD SESSION.

THURSDAY MORNING, APRIL 27, 1905.

Meeting called to order at 10.00 A. M., President WALMSLEY in the chair.

The following papers were read:

Analysis of the Detaching and Piceing Processes in Combing Machines.
JOHN W. NASMITH, Manchester, England.

Discussed by Messrs. HERBERT E. WALMSLEY and O. B. PARKER.

The Cloth Room and Its Equipment.
EDWIN H. MARBLE, Worcester, Mass.

Discussed by Mr. DANIEL MOORE BATES.

Batten and Hayes Additional Top Stripper on Revolving Flat Card.
WILLIAM HAYES, Auburn, Maine.

Discussed by Messrs. JOHN W. NASMITH and J. R. MONTGOMERY.

REPORT OF NOMINATING COMMITTEE.

The PRESIDENT. We are now ready to receive the report of the committee appointed yesterday to nominate a list of officers for the vacancies to be filled for the ensuing year.

Mr. GEORGE OTIS DRAPER. By request of the chairman of our committee I present the report they have to offer.

We hereby offer the following names for consideration:

PRESIDENT.

JAMES R. MACCOLL, PAWTUCKET, R. I.

VICE PRESIDENTS.

WILLIAM D. HARTSHORNE, LAWRENCE, MASS.

GEORGE A. AYER, EASTHAMPTON, MASS.

DIRECTOR TO SERVE TWO YEARS.

WILLIAM H. LOFTUS, NEWARK, N. J.

DIRECTORS TO SERVE THREE YEARS.

CHARLES T. PLUNKETT, ADAMS, MASS.

ROSCOE S. MILLIKEN, NASHUA, N. H.

ROBERT BURGESS, *Chairman.*
GEORGE OTIS DRAPER,
PARDON B. SANDFORD.
Committee.

The PRESIDENT. Gentlemen, what is your pleasure in the matter?

Mr. ARTHUR MCARTHUR. I move, Mr. President, that this report be accepted.

The motion was put to vote and carried, and the President appointed as a committee to distribute and collect the ballots Messrs. DANIEL MOORE BATES, WILLIAM L. LYALL and WILLIAM H. CADWELL, which committee thereupon proceeded to the discharge of their duty.

The committee subsequently submitted through its chairman, Mr. DANIEL MOORE BATES, the following report:

BOSTON, April 27, 1905.

To the New England Cotton Manufacturers' Association:

Your committee, who were appointed to distribute, collect and count the ballots for officers of this Association, report that eighty-three ballots have been cast for each of the following nominees:

PRESIDENT.

JAMES R. MACCOLL, PAWTUCKET, R. I.

VICE PRESIDENTS.

WILLIAM D. HARTSHORNE, LAWRENCE, MASS.

GEORGE A. AYER, EASTHAMPTON, MASS.

DIRECTOR TO SERVE TWO YEARS.

WILLIAM H. LOFTUS, NEWARK, N. J.

DIRECTORS TO SERVE THREE YEARS.

CHARLES T. PLUNKETT, ADAMS, MASS.

ROSCOE S. MILLIKEN, NASHUA, N. H.

Respectfully submitted,

DANIEL MOORE BATES, *Chairman.*
WILLIAM L. LYALL,
W. H. CADWELL.
Committee.

The PRESIDENT. You have heard the report of the tellers, and the gentlemen named having received the requisite number of votes, I now declare them duly elected as the officers of this Association for the ensuing year.

The following papers were read:

The Barber Warp Tying Machine.
E. W. THOMAS, Columbia, S. C.

Discussed by Mr. GEORGE OTIS DRAPER.

Boiler Plants in Bleaching and Dyeing Mills.
GEORGE I. ROCKWOOD, Worcester, Mass.

Discussed by Messrs WILLIAM D. HARTSHORNE and C. J. H. WOODBURY.

FOURTH SESSION.

THURSDAY AFTERNOON, APRIL 27, 1905.

Meeting called to order at 2.30 P. M., President WALMSLEY in the chair.

The PRESIDENT. If you will kindly come to order the Secretary has two or three notices to give.

The SECRETARY. I have been asked to give notice in regard to the excursion to Knoxville, of which the details are set forth in a circular from the railroads acting in conjunction with each other, and this circular may be found on the table in the entry. Messrs. DANIELS and GAITHER of the railroads are in the hall and prepared to give full information.

ELECTION OF MEMBERS.

The PRESIDENT. We will now proceed to the election of new members, and the Secretary will have the ballots distributed according to the by-laws. I will appoint as a committee to assort and count the ballots Messrs THOMAS G. COX, JOHN H. BURGHARDT and GEORGE I. ROCKWOOD. Gentlemen, will you kindly attend to this duty.

Mr. WALTER E. PARKER. I move that the Secretary cast one ballot for the names on this printed list.

The PRESIDENT. It is moved and seconded that the Secretary cast one ballot to represent the unanimous choice of the meeting. (The motion prevailed.)

The SECRETARY. I cast this as my ballot for the names that are set forth thereon.

The PRESIDENT. The Secretary has cast one ballot for the following names offered for new membership to this Association by the Board of Government, and they are thereby unanimously elected to the Association.

FOR ACTIVE MEMBERSHIP.

ALLIS, JOHN W., Vice-Pres. and Agt. Utica Knitting Co., Utica, N. Y.
By P. B. SANFORD.

CLARK, AVERY B., Supt. Merrimack Mfg. Co., Lowell, Mass.
J. C. WADLEIGH.

DENNETT, HARLAN INGALLS, Supt. Hadley Mills, South Hadley Falls, Mass.
By CHARLES W. DENNETT.

DEXTER, GEORGE O., Supt. Canadian Colored Cotton Mills Co., Hamilton, Ont.
By CHARLES O. DEXTER.

DRESSER, HENRY C., Gen. Supt. Bibb Mfg. Co., Macon, Ga.
By H. B. HOPSON.

FISH, GEORGE, Supt. Massachusetts Cotton Mills, Lowell, Mass.
By W. S. SOUTHWORTH.

GODDARD, R. H. I., Jr., Goddard Bros., Agts. Lonsdale Co., etc., Providence, R. I.
By NATHANIEL F. AYER.

HARTLEY, FRANK, Supt. S. Slater & Sons, Webster, Mass.
By WILLIAM J. STEWART.

HOBBS, ALEXANDER F., Asst. Mgr., U. S. Finishing Co., Norwich, Conn.
By FREDERICK A. FLATHER.

KING, ALEXANDER, JR., Asst. Supt. American Thread Co., Holyoke, Mass.
By GEORGE A. AYER.

KIRK, JOHN T., Supt. Slater Cotton Co., Box 697, Pawtucket, R. I.
By ROBERT BURGESS.

JENCKES, EARL S., Supt. Paul Whitin Mfg. Co., Northbridge, Mass.
By PAUL WHITIN.

LORD, HARRY D., Instr. Carding and Spinning, Mississippi Textile School, Agricultural College, Miss.
By WILLIAM E. WINCHESTER.

MALLORY, J. D., Supt. John M. Stone Cotton Mill, Starkville, Miss.
By WILLIAM E. WINCHESTER.

MOWRY, HAROLD, Mgr. Sterling Branch U. S. Finishing Co., Sterling, Conn.
By A. F. BRACKETT.

PAUL, ARTHUR H., Asst. Supt. Boston Mfg. Co., Waltham, Mass.
By ARTHUR C. FREEMAN.

PRATT, ALBERT S., Agt. Edwards Mfg. Co., Augusta, Maine.
By WILLIAM HAYES.

ROONEY, JOHN J., Asst. Supt., Tremont and Suffolk Mills, 151 Cabot St., Lowell, Mass.
By JOHN H. DUNN.

RUSSELL, LEWIS H., Supt. Ansonia Co., Ansonia, Conn.
By FREDERIC W. EASTON.

SMITH, STEPHEN E., Instr. Lowell Textile School, Lowell, Mass.
By A. G. CUMNOCK.

TABOR, CHARLES A., Supt. Thorndike Mills, Thorndike, Mass.
By C. H. HOBBS.

THOMSON, CHARLES R., Asst. Gen. Supt. Renfrew Co., Adams, Mass.
By RALPH E. THOMSON.

UMPLEBY, FENWICK, Instr. Lowell Textile School, Lowell, Mass.
By JOHN N. NELSON.

WOOLEY, FRANK F., Supt. Coventry Co., Anthony, R. I.
By CHARLES H. COLLINS.

FOR ASSOCIATE MEMBERSHIP.

BRAMAN, SAMUEL N., Engineer Westinghouse Machine Co., 131 State St., Boston, Mass.
By WILLIAM D. HARTSHORNE.

COLMAN, HOWARD D., Pres. and Treas. Barber-Colman Co., Rockford, Illinois.
By EDWARD W. THOMAS.

EAGER, CHARLES E., Member firm J. Russel Marble & Co., 124 High St., Boston, Mass.
By ROBERT W. NEFF.

ERHARD, GEORGE P., Vice-Pres. The Geo. W. Stafford Co., Readville, Mass.
By JOHN H. NELSON.

GREENE, S. HAROLD, Starch Manufacturer, 367 Atlantic Ave., Boston, Mass.
By SIDNEY B. PAINE.

GREENOUGH, ALLEN B., Harrison Yarn and Bleaching Co., Taunton, Mass.
By CHARLES E. HARRISON.

HATHAWAY, EDWARD F., Gen. Mgr., American Warp Drawing Machines, 289 A St., Boston, Mass.
By D. M. THOMPSON.

MASON, HENRY W., Cotton Dealer, 10 South Water St., Providence, R. I.
By FREDERICK B. MACY.

PARMENIDES, JOHN, of Choremi, Benachi & Co., 50 Congress St., Boston, Mass.
By O. B. TRUESDELL.

SANFORD, J. L., Barber-Colman Co., 11 Pemberton Sq., Boston, Mass.
By FRED A. WILDE.

SWIFT, E. KENT, Whitin Machine Works, Whitinsville, Mass.
By JOSIAH M. LASELL.

WARR, WILLIAM, Engineer, Robins' Conveying Belt Co., 53 State St., Boston, Mass.
By WILLIAM D. HARTSHORNE.

The following papers were read:

Progress in the Development of the Electric Drive.
SIDNEY B. PAINE, Boston, Mass.

Discussed by Messrs. GEO. I. ROCKWOOD, R. W. EATON, J. R. MONTGOMERY and Mr. JOHN A. FERNLEY.

Measurement of Power Required in Manufacturing Heavy Cotton Goods.
LOUIS I. GUION, Columbia, S. C.

Discussed by Messrs. GEORGE I. ROCKWOOD, SIDNEY B. PAINE and EDWIN H. MARBLE.

Motor Drive as Applied to Cotton Mills.
MELDON H. MERRILL, Boston, Mass.

Discussed by Messrs. WALTER E. PARKER, SIDNEY B. PAINE, DANIEL MOORE BATES and FRANK B. PERRY.

RESOLUTION OF THANKS TO THE PRESIDENT.

Mr. S. A. KNIGHT. If in order I have a resolution to offer at this time.

Be it resolved, That the Association's hearty thanks be tendered to our retiring President, Mr. HERBERT E. WALMSLEY, for his faithful and efficient oversight over our Association during the term of his office.

I would make that as a motion.

This motion was seconded.

The SECRETARY. You have heard the motion personal to the President; is there any discussion upon it? Those in favor please say aye.

The motion was unanimously carried followed by applause.

The PRESIDENT. Gentlemen, I accept with satisfaction and a far greater appreciation than I can express this flattering testimony of your good opinion and good will.

I have always esteemed it a very great honor, and ever shall esteem it a great honor, to have been the President of this Association. It is a distinction worthy the ambition of every member of the Association.

I return, gentlemen, to the ranks none the less prepared to devote the best that is in me to the future welfare of this organization, and it now merely devolves upon me, gentlemen, to present to you my successor, your newly-elected President, Mr. JAMES R. MACCOLL.

I congratulate the Association sincerely in its choice, and I do not hesitate to predict that under his leadership as President this Association will increase in usefulness, in influence, and in power.

ADDRESS OF THE PRESIDENT ELECT.

MR. JAMES R. MACCOLL.

Mr. Walmsley and Gentlemen: I thank you very cordially for the honor conferred upon me, and for the unanimity of the election.

Discussing life, you may remember that SIDNEY SMITH has remarked that the parts in life are like holes of different shapes in the table, triangular, oblong, square or round, and that the persons who play the parts are like pieces of wood of the same shapes, but very often the triangular person gets into the oblong hole, and the square person squeezes himself into the round hole, and that very seldom the officer fits the office so exactly that you can say the one is made for the other. I hope in this instance it is not another case of the square man getting into the round hole.

I can only promise you that I will give you the best that is in me, and strive to use all my ability in thought and work for the best interests of the Association.

Our Association has had continuous progress and development. We have had a long succession of able and active men as presidents, who have guided the Association in a conservative and yet progressive way; we have had Directors who have given a great deal of time, thought, and counsel to the Association; and we have had an exceptional man as secretary, who during the last ten years has given, not intermittent, but continuous attention day by day to the work of the Association, and has seen that everything went along smoothly. It seemed to me eminently fitting that we should recognize, as we did yesterday, this long and faithful service.

In this connection you will allow me to refer to two matters, as I was chairman of the committee having charge of the testimonial. The secretary of the committee was Mr. C. P. BROOKS, and as he did almost all the work, the thanks of the Association are due to him for this valuable assistance. I have been asked to call your attention to the inscription on the clock, which is neatly engraved in the lower part of the dial. The inscription reads as follows:

Presented to C. J. H. Woodbury by the members of the New England Cotton Manufacturers' Association, in token of esteem and appreciative recognition of ten years of faithful service as Secretary and Treasurer, Boston, Mass., April 26, 1905.

But in addition to all this a great deal depends on the members themselves, their willingness to prepare papers, their regular attendance at the meetings, and their active participation in the discussions that take place; and it is to be hoped that in the days to come there will be continued and increasing interest in the work of this Association.

Like all business enterprises this Association cannot stand still. Fixity is really retrogression. The world keeps moving on, and unless we keep pace with it we are out of the procession; and it seems to me that our Association now has many problems and opportunities confronting it. I will take the liberty of mentioning some of these which occur to me, and leave them with you for consideration. I make no suggestion as to the solution of these problems, but simply put them before you.

Is the name of our Association representative of its scope and importance, and is there not a possibility that we may not fully grasp our opportunity if we do not have a wider and more representative name?

Then the question arises, shall we confine ourselves solely or mainly to the discussion of technical questions, and ignore commercial and political questions in which we are intensely interested as cotton manufacturers? We must remember that many of our members are not very deeply interested in the

technical side of our business. One treasurer when asked if he was coming to this meeting said, "No; I do not feel any special interest; it deals with matters inside the mills, in which I am not much interested." We must not forget that a large number of our members are of this class.

In connection with commercial affairs, we had, for instance, a suggestion from Mr. PRICE yesterday, that as an association we should give attention to the shipments and adjustment of claims on cotton. Evidently outsiders rather think that we ought to take a more aggressive part in such questions.

Recently we were asked to associate ourselves with the International Congress of Cotton Manufacturers, and the Board of Government felt it was not quite within the province of this Association. I do not know whether we have any international interests, or whether we should decide that we have no need to associate ourselves in any way whatever with the cotton manufacturers' association of other countries.

As regards political matters, we have the tariff coming up again very soon, and when the cotton schedule is arrived at, it seems very proper that our Association should be looked to, to exert its influence in securing a satisfactory readjustment of the cotton schedule. At all events, our legislators in Washington must depend on some association to guide them in this important subject.

The Speaker of the House yesterday referred to hours of labor as becoming more and more a national, rather than a state question. This problem is ever before us; it is of vital interest to us as cotton manufacturers. Has this Association any interest in it, or shall it decide that it is outside its province?

There is also the question of child labor in mills, which is of great importance, and of taxation, which a strong representative association should have great influence in settling wisely and fairly.

I think we might consider also, in what way we can associate with kindred branches of manufacture. It is a remarkable fact that a very large percentage of cotton mills are now using

other materials; worsted, wool, linen and silk. On the other hand, a very large number of worsted, woolen, linen and silk mills are using cotton. Men in similar positions to ours in these industries have no technical organization that they can associate themselves with — in New England, I mean — and it becomes a question whether we could in any way add to the strength of our membership by having them associate with us, and in that way receive ideas from them and give ideas helpful in their business.

It was suggested to me by a member today, that when we gather at our annual meeting we should have a social gathering, possibly a banquet. That is worthy of consideration.

I leave these suggestions with you, for your thought and discussion, so that the Board of Government may be able to ascertain what the wishes of the members are with regard to them.

I promise you my best service; I ask your cordial co-operation, and thank you very sincerely. [Very great applause.]

President MACCOLL. I now declare the convention adjourned.

(Adjourned at 4 o'clock P. M.)

Attest:

C. J. H. WOODBURY,

Secretary.

TRANSACTIONS.

FIRST SESSION.

WEDNESDAY MORNING, APRIL 26, 1905.

The Association met in Chipman Hall, Boston, at 11 A. M., President WALMSLEY in the chair.

The PRESIDENT. We now come to the first paper on the program, on the New Classification of Color, by Mr. A. H. MUNSELL of Boston.

A NEW CLASSIFICATION OF COLOR.

A. H. MUNSELL, Boston, Mass.

There is no practical color system in general use to-day, Each occupation has devised different methods, so entirely at variance that it is quite impossible to translate the color terms of one trade or art into another occupation.

Science deals with spectral hues, whose wave-lengths can be defined; but wave-lengths and Frauenhöfer lines mean nothing to the artist or the artisan, who is forced to use pigments instead of spectral color.

Art and industry are familiar with pigments such as vermilion, madder, sienna, umber and cadmium, while chemistry uses another set of terms, based on the proportions of dye-stuffs, or numbered arbitrarily. Thus the same color is known as 2,309

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upon one card and 7½ on another, and these numbers change from season to season.

The incongruous and bizarre nature of our present color names must appear to any thoughtful person. Baby blue, peacock blue, Nile green, apple green, lemon yellow, straw yellow, rose pink, heliotrope, royal purple, magenta, solferino, plum, and automobile are popular terms, conveying different ideas to different persons but utterly failing to define colors. The terms used for a single hue, such as pea green, sea green, olive green, grass green, sage green, evergreen, invisible green, are not to be trusted in ordering a piece of cloth. They invite mistakes and disappointment. Not only are they inaccurate: they are inappropriate. Can we imagine musical tones called lark, canary, cockatoo, crow, cat, dog, or mouse, because they bear some distant resemblance to the cries of those animals?

Music is equipped with a system by which it defines each sound in terms of its pitch, intensity, and duration, without dragging in loose allusions to the endlessly varying sounds of nature. So should color be supplied with an appropriate system, based on the ***hue***, ***value***, and ***chroma*** of our sensations, and not attempting to describe them by the indefinite and varying colors of natural objects. The system now to be considered portrays the three dimensions of color (Fig. 1), and measures each by an appropriate scale. It does not rest upon the whim of an individual, but upon physical measurements made possible by special color apparatus. The results may be tested by any one who comes to the problem with "a clear mind, a good eye, and a fair supply of patience."

The three color qualities are ***hue***, ***value***, and ***chroma***.

HUE IS THE NAME OF A COLOR.

Hue is the quality by which we distinguish one color from another, as a red from a yellow, a green, a blue, or a purple. This names the hue, but does not tell whether it is light or dark, weak or strong, — leaving us in doubt as to its value and its chroma.

Science attributes this quality to difference in the length of

ether waves impinging on the retina, which cause the sensation of color. The wave length M. 5,269 gives a sensation of green, while M. 6,867 gives a sensation of red.

VALUE IS THE LIGHT OF A COLOR.

Value is the quality by which we distinguish a light color from a dark one. Color values are loosely called tints and shades, but the terms are frequently misapplied. A tint should be a light value, and a shade should be darker; but the word "shade" has become a general term for any sort of color, so that a shade of yellow may prove to be lighter than a tint of blue. A *photometric scale of value will place all colors in relation to the extremes of white and black, but cannot describe their hue or their chroma.

Science describes this quality as due to difference in the height or amplitude of ether waves impinging on the retina. Small amplitudes of the wave lengths given above, produce the sensation of dark green and dark red: larger amplitudes give the sensation of lighter green and lighter red.

CHROMA IS THE STRENGTH OF A COLOR.

Chroma is the quality by which we distinguish a strong color from a weak one. To say that a rug is strong in color gives no hint of its hues or values, only its chromas. Loss of chroma is loosely called fading, but this word is frequently used to include changes of value and hue. Take two autumn leaves, identical in color, and expose one to the weather, while the other is waxed and pressed in a book. Soon the exposed leaf fades into a neutral gray, while the protected one preserves its strong chroma almost intact. If, in fading, the leaf does not change its hue or its value, there is only a loss of chroma, but the fading process is more likely to induce some change of the other two qualities. Fading, however, cannot define these changes.

Science describes chroma as the purity of one wave length separated from all others. Other wave lengths, intermingling,

* The Munsell Photometer; patented 1901.

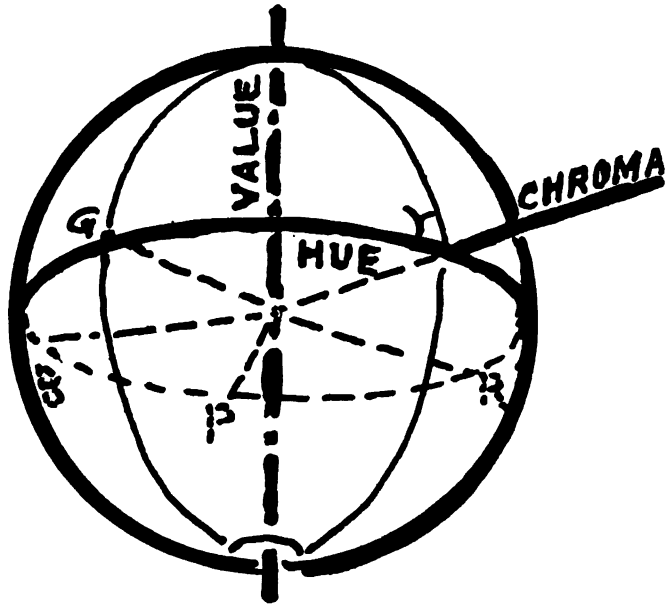


FIGURE 1.

make its chroma less pure. A beam of daylight may combine all wave lengths in such balance as to give the sensation of whiteness, because no single wave is in excess.

The color sphere (see Fig. 1) is a convenient model to illustrate these three qualities, — hue, value, and chroma, — and unite them by measured scales.

The north pole of the color sphere is white and the south pole black. Value or luminosity of color ranges between these two extremes. This is the vertical scale, to be memorized as *V*, the initial for both value and vertical. Vertical movement through color may thus be thought of as a change of value, but not as a change of hue or of chroma. Hues of color are spread around the equator of the sphere. This is a horizontal scale, memorized as *H*, the initial for both hue and horizontal. Horizontal movement around the color solid is thus thought of as a change of hue, but not of value or of chroma. A line inward from the strong surface hues to the neutral gray axis,

traces the graying of each color, which is loss of chroma, and conversely a line beginning with neutral gray at the vertical axis, and becoming more and more colored until it passes outside the sphere, is a scale of chroma, which is memorized as *C*, the initial both for chroma and centre. Thus the sphere lends its three dimensions to color description, and a color applied anywhere to its surface or within, or without it, is located and named by its degree of hue, of value, and of chroma.

THREE DIMENSIONS NEEDED TO DEFINE A COLOR.

The omission of any one of these three dimensions leaves us in doubt as to the character of a color, just as truly as the character of this studio would remain undefined if the length were omitted and we described it as 22 feet wide by 14 feet high. The imagination would be free to ascribe any length it chose, from 25 to 100 feet. This length could be conceived differently by every individual who tried to supply the missing factor.

The illustrate the tri-dimensional assemblage of colors. Suppose we peal an orange and divide it in five parts, leaving the sections slightly connected below (Fig. 2). Then let us say that all the reds we have ever seen are gathered in one of the sections, all yellows in another, all greens in the third, blues in the fourth, and purples in the fifth. Next we will assort the hues in each section so that the lightest are near the top, and grade regularly to the darkest near the bottom. A white wafer connects all the sections at the top, and a black wafer may be added beneath.

The fruit is then filled with assorted colors, graded from white to black, according to their *values*, and disposed by their *hues* in the five sections. A slice near the top will uncover light values in each hue, and a slice near the bottom will uncover dark values in the same hues. A slice across the middle discloses a circuit of hues all of *middle value*, that is, midway between the extremes of white and black.

Two color dimensions are thus shown in the orange, and it remains to exhibit the third, which is the chroma, or strength

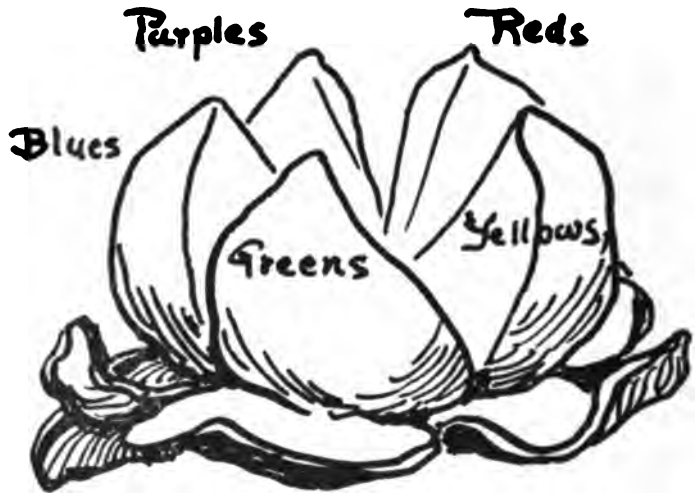


FIGURE 2.

of color. To do this, we have only to take each section in turn, and, without disturbing the values already assorted, shove the grayest in toward the narrow edge, and grade outward to the purest on the surface. Each slice across the fruit still shows the circuit of hues in one uniform value; but the strong chromas are at the outside, while grayer and grayer chromas make a gradation inward to neutral gray at the centre, where all trace of color disappears. The thin edges of all sections unite in a scale of gray from black to white, no matter what hue each contains.

The curved outside of each section shows its particular hue graded from lightest to darkest value; and, should the section be cut at right angles to the thin edge, it would show the third dimension,— chroma,— for the color is graded evenly from the surface to neutral gray. A pin stuck in at any point traces the third dimension.

Much popular misunderstanding of color is caused by ignorance of these three dimensions, or by an attempt to make two dimensions do the work of three.

Flat diagrams showing hues and values, but omitting to define

chromas, are as incomplete as would be a map of Switzerland with the mountains left out, or a harbor chart without indications of the depth of water. Measuring instruments discover that pigments are very unequal in this third dimension, — chroma, — producing mountains and valleys on the color sphere, so that, when the color system is worked out in pigments and charted, some colors must be traced well out beyond the spherical surface. Indeed, a *color tree* is needed to display by the unequal levels and lengths of its branches the individuality of pigment colors. But, whatever solid or figure is used to illustrate color relations, it must combine the three scales of hue, value, and chroma, and these definite scales furnish a name for every color, based upon its intrinsic qualities, and free from terms purloined in other sensations, or caught from the fluctuating colors of natural objects.

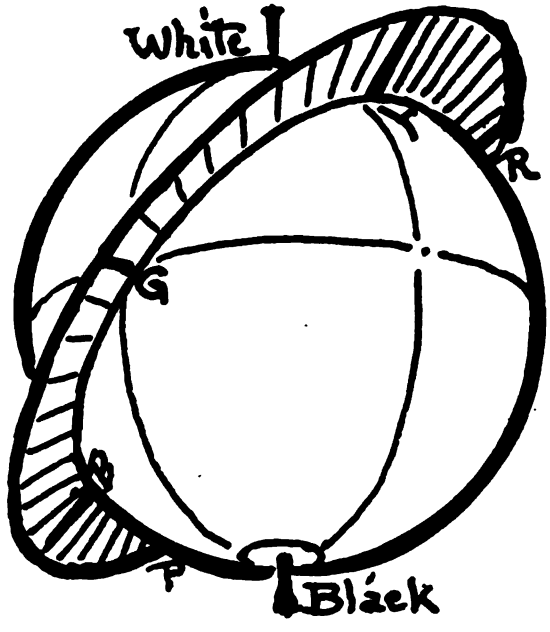


FIGURE 3.

The solar spectrum and rainbow are the most stimulating color experiences with which we are acquainted. Can they be described by this solid system? The lightest part of the spectrum is a narrow field of greenish yellow, grading into darker red on one side and into darker green upon the other, followed by still darker blue and purple. Upon the sphere these values of the spectral colors, trace a path high up on the yellow section, near white, and slanting downward across the red and green sections, which it traverses near the level of the equator, it goes on to cross the blue and purple well down toward black.

This forms an inclined circuit, Fig. 3, crossing the equator at opposite points, and suggests the ecliptic or the rings of Saturn. A pale rainbow would describe a slanting circuit nearer white, and a dimmer one would fall within the sphere, while an intensely brilliant spectrum projects far beyond the surface of the sphere, so greatly is the chroma of its hues in excess of the common pigments with which we work out our problems.

At the outset it is well to recognize the place of the spectrum in this system, not only because it is the established basis of scientific study, but especially because the invariable order assumed by its hues is the only stable hint which Nature affords us in her infinite color play.

All our color sensations are included in this color solid. None are left out by its scales of hue, value, and chroma. Indeed, the imagination is led to conceive and locate still purer colors than any we now possess. Such increased degrees of color sensation can be named, and clearly conveyed by symbols to another person as soon as the system is comprehended.

* * * * * * * *

Science teaches that all the infinite varieties of color are due to mingling, in various proportions, of three simple sensations, red, green and violet-blue. With a little effort of the imagination we can picture a prismatic color sphere, using only the colors of light. In a cylindrical chamber is hung a diaphanous ball similar to a huge soap bubble, which can display

color on its surface without obscuring its interior. Then, at the proper points of the surrounding wall, three pure beams of colored light are admitted: one red, another green, and the third violet-blue.

They fall at proper levels on three sides of the sphere, while their intermediate gradations encircle the sphere with a complete spectrum plus the needed purple. Penetrating the sphere, they unite to balance each other in neutrality. Pure whiteness is at the top, and, by some imaginary means that gradually diminishes their light, they disappear in darkness below.

This ideal color system is impossible in the present state of our knowledge and implements. Even were it possible, its immaterial hues could not serve to dye materials or paint pictures. Pigments are, and will in all probability continue to be, the practical agents of coloristic productions, however reluctant the scientist may be to accept them as the basis of a color system. It is true that they are chemically impure and imperfectly represent the colors of light. Some of them fade rapidly and undergo chemical change, as in the notable case of a green pigment tested by this measured system, which in a few weeks lost four steps of chroma, nearly two steps of value, and swung into a bluer hue.

But the pigment color sphere is worked out with a few reliable pigments, mostly natural earths, whose fading is a matter of years and so slight as to be almost imperceptible. Besides, its principal hues are preserved in safe keeping by imperishable enamels, which can be used to correct any tendency of the pigments to distort the measured intervals of the color sphere.

COLOR CHARTS, AND A COLOR CODE.

The practical application of this measured color system, is supplied in a convenient color *atlas*, *i. e.*, a set of charts, displaying an orderly arrangement, so that any kind and degree of color is defined and recorded with ease.

Horizontal sections of the color solid display a single level of colors, and are numbered from 0 (black) to 100 (white).

Vertical sections display a single hue at every level, and are indicated by the initials R, YR, Y, GY, G, BG, B, PB, P and RP, with ten subdivisions of each hue.

Inclined sections give a series of spectra, from the palest to the darkest.

All these charts, and the hundreds of colors which they bear, are exactly classified by this decimal system. The five color initials R, Y, G, B, and P; with nine numerals, 1, 2, 3, 4, 5, 6, 7, 8, 9, furnish a *code*, by which any color may be telegraphed to any part of the world. Manufacturers adopting this system, can thus clearly express their color ideas to others, can draw contracts, and if need be, defend them legally.

The short time alloted to this subject makes it necessary to defer the discussion of other practical points which are more fully treated elsewhere,* and sum up the advantages of such a new classification of color as is here outlined.

1. Loose aud unrelated color terms are replaced by a definite notation.

2. Each color names itself by its degree of hue, value and chroma.

3. Each color can be recorded and transmitted by a code.

4. Color contracts can be drawn, and proved by physical tests.

5. New colors in no way disturb the orderly classification, as a place is already awaiting them.

6. Fading can be defined and plotted at certain intervals, showing its progress in terms of hue, value and chroma.

The PRESIDENT. If any gentleman desires to ask Mr. MUNSELL any questions the opportunity is granted to do so.

Mr. WILLIAM D. HARTSHORNE. As a practical question relating to the method of use of such an apparatus, is there any

* A Color Notation, by A. H. Munsell, George H. Ellis Co., Boston, 1905.

way by which we could control the character of the light by which we may observe the color?

Mr. A. H. MUNSELL. The photometer is fitted with an electric lamp whose voltage is kept constant, through a device suggested by Mr. R. R. LAWRENCE of the Institute of Technology, thus furnishing a standard light for color measurements. Formerly the measurements were made at the time of the equinox, and when possible, at about noon of a rainy day.

Mr. CHARLES W. DENNETT. It seems to me that this paper we have heard, and this demonstration we have seen, may be made very practical in the designing room where many colors are used. Some years ago, when I was designing and used as many as ninety different shades of yarn in two seasons, it was necessary to name the colors in groups for convenient reference in writing out patterns. A great saving of time is made if the arrangement is right. It also assists the memory of the designer in combining his colors. It seems to me, from what I have gathered from the professor's talk, that his system may be made very practical and useful in the arrangement and cataloguing of colors in the designing room.

Mr. WILLIAM D. HARTSHORNE. As Mr. MUNSELL is not a member of the Association I would suggest that we give him a very hearty vote of thanks for this very able paper.

This was made a motion and duly carried.

The PRESIDENT. The next paper is Static Electricity Neutralized, by Mr. DANA of Westbrook, Maine.

I do not think Mr. DANA is in the room, and as it is an important question the Secretary will read the paper and the discussion may be taken up at some later session.

It is the first of the scientific methods, I believe, in meeting by electrical difficulties, truly fighting fire with fire.

STATIC ELECTRICITY NEUTRALIZED.

PHILIP DANA, Westbrook, Maine.

Static electricity has been tersely described as a pressure of electricity, rather than a current of electricity.

Most of us familiar with the manufacture of cottons have run up against it on cold, dry mornings, either in a card or drawing frame, and have wished for some method to overcome it completely.

It has been found necessary to keep a fairly high degree of temperature and humidity in rooms; partly to obtain more uniform and stronger work and partly to overcome this static electricity. The necessary degree of heat is easy to obtain, but it is hard to have, when first starting the machinery, a sufficient amount of humidity without the use of very moist steam, always unhealthy, or without having a separate power plant for running humidifiers before the machinery is started up.

In the dyeing of warps, we have used the long chain system and the straw patent winding and unwinding machines. The warps, coming from the drying cans very dry, are passed through an unwinding machine for the removal of a protection thread used when dyeing and then run between carrier rolls and down through folding trumpets or shutes.

The warps, particularly those made from long stapled combed Egyptian or peeler stock, becomes thoroughly charged with electricity passing through the carrier rolls and cling to the trumpets, becoming very much snarled up and cutting down production on winders and beamers.

We have applied the Chapman process of removing static

electricity to our unwinding machines with entire success and expect to be able to use it the coming winter on our drawing frames, especially where we use long stapled cottons, both carded and combed.

The device consists of

"1st, a source of alternating current." (Any 110 or 220 volt alternating lighting system.)

"2nd, a transformer to step the alternating current up in voltage to an amount somewhere between 10,000 and 20,000 volts."

"3rd, an inductor to distribute this high voltage current over the substance to be treated."

The inductors are fine steel wires and are incased in hard rubber, the fine steel points being flush with the rubber case.

The principle on which it works is as follows:

"A static charge spontaneously selects from a neighboring alternating charge, the kind and quantity of electric current to exactly neutralize itself." If the static charge happens to be positive, it would take from the inductors enough negative current to neutralize itself and vice versa.

Static electricity in any material is very small in quantity, although of very high voltage, and the quantity required to kill it is correspondingly small. This facts allows the transformers to be constructed so as to limit the maximum output to a few mil-amperes, thus making it perfectly safe for a person to take the whole charge.

While this process has had a limited application in cotton manufacturing, it has, in other branches of manufacture, been extensively used.

On paper machines, paper bag machines and printing presses, it has been of very great value, the production being more than doubled in some cases. Some woolen mills have used it successfully on their cards and another firm has used it on their

shearing machines, finding it much easier to brush off from the cloth the dust and short fibres from shearing, where no static electricity existed.

The PRESIDENT. That concludes the business of the morning session, and we will adjourn to meet at 2.00 P. M.

SECOND SESSION.

WEDNESDAY AFTERNOON, APRIL 26, 1905.

The Association met in Chipman Hall at 2.00 P. M., President WALMSLEY in the chair.

The PRESIDENT. The gentlemen will please come to order. We are now to be favored with a paper on The Relationship between the Planter and the Manufacturer: Its Unnecessary Antagonisms, by Mr. THEODORE H. PRICE of New York City.

You are doubtless all well aware that anything Mr. PRICE may have to say upon the cotton question is of worldwide interest. When such a busy man, such a unique personality as Mr. PRICE, not only finds time to write a paper but to come before this Association and deliver it in person, the Association is to be congratulated.

Mr. THEODORE H. PRICE. Mr. President and gentlemen; I am highly appreciative of the honor and the privilege of this second appearance before you, and I value the opportunity it gives me of coming in contact with the captains of industry in the cotton manufacturing business more than I can say; and I step upon this platform with a very definite feeling of satisfaction derived from my conversation with those of this audience I have met personally, in the tremendous contrast that they

describe as between the condition of the cotton manufacturing industry today and a year ago when I had the pleasure of appearing before you.

A year ago everyone was in doubt. Many expressed themselves in the most depressing terms, both as to the past and as to the future. Today everybody seems cheerful. I am utterly surprised, if you will excuse a little personality, with my previous bearish convictions with regard to the market, to find what a very cheerful feeling pervades the cotton industry and the ultimate buyer, the spinner.

Your President has allowed me to select my own subject for this address, and it has seemed to me that as there has grown up this year, unfortunately but unquestionably, a feeling of antagonism between the cotton producer and the ultimate buyer — the spinner, — a few words pertinent to this subject would be interesting. That such a feeling should exist is regretable, but believing that it does exist I have been led to the preparation of the paper I am about to read to you.

THE RELATIONSHIP BETWEEN THE PLANTER AND THE MANUFACTURER: ITS ANTAGONISMS.

THEODORE H. PRICE, New York, N. Y.

The Arkansas Legislature has recently passed, and the Governor has signed, a law which contains among others the following provisions:

"Any corporation organized under the laws of this or any other state or country and transacting or conducting any kind of business in the state, or any partnership of individuals or other associations of persons whatsoever, who are now or shall hereafter create, enter into, become a member of or a party to any pool, trust, agreement, combination, confederation or understanding, whether the same is made in this state or elsewhere with any other corporation, partnership, individual, or any other person or association of persons, to regulate or fix either in this state or elsewhere the price of any article of manufacture, mechanism, merchandise, commodity, convenience, repair, any product of mining or any article or thing whatsoever, or the price or premium to be paid for insuring property against loss or damage by fire lightning or tornado, or to maintain said price when so regulated or fixed, or who now or shall hereafter enter into, become a member of, or a party to any pool, agreement, contract, combination, association, or confederation, whether made in this state or elsewhere, to fix or limit in this state or elsewhere the amount or quantity of any article of manufacture, mechanism, merchandise, commodity, convenience, repair, any product of mining, or any article or thing whatsoever, or the price or premium to be paid for insuring property against loss or damage by fire, lightning, storm, cyclone, tornado, or any other kind of policy issued by any corporation, partnership, individual, or association of persons aforesaid, shall be deemed and adjudged guilty of a conspiracy to defraud and be subject to the penalties as provided by this act."

This law was intended primarily to protect the citizens of Arkansas against the exactions of the so-called "trusts" and to prevent agreements between insurance companies to maintain rates, but is equally applicable to any two individuals who shall agree not to sell their cotton below a specified price, or to limit their production of cotton, either by a reduction of acreage or otherwise.

If the newspaper reports are true, a large portion of the agricultural population of Arkansas are under this law "guilty of a conspiracy to defraud."

I doubt if any of them will be so prosecuted and the law itself will probably be adjudged unconstitutional. I call attention to it, however, as it emphasizes the inconsistency of Southern protest against trust exactions while the South is today largely engaged in a futile endeavor to create one of the most oppressive trusts with which the world's progress was ever threatened. That this attempt will fail is a foregone conclusion. That the widely advertised agreement to "hold cotton for ten cents" has already come to naught is evidenced by the quantity of cotton being shipped daily at seven and a half cents, and the purpose of this address is not to combat a movement which has already collapsed, but to point out the mistakes in which it was conceived in the hope that the loss of energy and money which it has caused may be to some extent avoided in the future.

The South produces a practical monopoly of the civilized world's cotton production. The cost of cotton production as ascertained by the United States Government for the crop of 1896–7 was on the average 4.90 cents per lb., after allowing for a land rental of $2.91 per acre, the net cost in that year being, therefore, about 4 cents per lb. The production that season was 172 lbs. per acre. The production this year is 240 lbs. per acre, and the indicated cost, therefore, 25 per cent. less, or probably not over 3¼ cents per lb., after allowing for the increased cost of picking. Ten cents per pound would, therefore, represent a profit of 200 per cent., while 7 cents per lb. means a profit of 100 per cent.

If any organized monopoly attempted to realize such profits as these, there is no doubt that legislation would find a way to deal with it, or that competition would speedily invade its field. Already this is being attempted, and although the efforts that are being made to encourage the cultivation of American cotton in Africa have not as yet been productive of any important addition to the world's supply, it is well to bear in mind that cotton production in the United States is only one hundred years old, and it is quite possible that many now within the sound of my voice will live to see an African cotton crop of from five to ten million bales per annum seriously threaten the monopoly of the Southern states as cotton producers. Monopolies, it is well to bear in mind, have only been successful and permanent when controlled by a policy the object of which has been to expand consumption through a reduction in the cost of production. This, in fact, has been the secret of monopolistic or trust success, where success has been achieved. In America, despite a clamor which seeks to create a contrary impression, the cost of nearly all trust-controlled manufactured articles has been continually tending toward lower figures. This is conspicuously true of the great exemplar of all successful trusts, namely, the Standard Oil Co. It is equally true of railroad transportation and the problem which the successful railroad manager has to face today is not how to increase his freight rates, but rather how to reduce them and at the same time how to reduce the cost of his transportation. As a result of this policy the consumption of American products in nearly all departments of industrial activity has shown the enormous increase which is expressed in the prosperity of today. The cotton trade alone is an exception. The consumption of American cotton for the season of 1898–9, according to Mr. ELLISON, was 10,695,000 bales. The consumption for the season of 1903–4, some six years later, was 10,273,000, an actual decrease during the period of nearly four per cent. For the current season Mr. ELLISON estimates the consumption of American cotton at 11,030,000, an increase as compared with seven years ago of less than four per cent. Is there any department of the world's

activity that in the past seven years shows so little progress as this? Is there any department in industrial activity in which the promise of healthy expansion has been greater than in the cotton trade and in which this promise has been so disappointed? Certainly none that I know of.

Why is it that the cotton trade alone is an exception to the industrial progress generally characteristic of the past decade? The answer in my opinion, is not hard to make, nor the reason far to seek. It is that the South, in the fancied security of its monopoly of cotton production, has been endeavoring to increase its profits by advancing the price of its product rather than by reducing the cost of its production. Misguided as this policy in my opinion is, the efforts that are being made towards its adoption in connection with the cotton crop for which the South is now preparing seem to be more strenuous than ever. In the "Chattanooga News" of March 16, 1905, I read the following:

"B. DIXON ARMSTRONG, an officer of the Southern Cotton Growers Association, is in the city. Mr. ARMSTRONG reports great enthusiasm and wonderful results up to the present hour in the organization of the association. For instance, he states that out of 812 cotton-growing countries in the South, 729 have been heard from, and more than two-thirds of those heard from have been thoroughly organized. The others are receiving the earnest consideration of the central organization, and organizers will be sent to each country not organized within the next few days. In speaking of this work, Mr. ARMSTRONG said: 'Four hundred and eighty-six thoroughly organized countries report a reduction in acreage averaging 27½ per cent., and reduction in the use of commercial fertilizers of from 30 to 40 per cent. The remaining 233 countries in process of thorough organization, though not yet complete, show an average of 22¼ per cent. reduction in acreage and 30 per cent. reduction in the use of commercial fertilizer. The number of signers of the pledge and members of the association up to noon yesterday is estimated to be 1,200,000. By reason of incomplete reports, which are being revised, this cannot be accurately stated, but we feel sure that it is conservative, and by June 1st, we confidently expect and do not doubt we will have two million members. Reports from the entire South show that no farmers are offering for sale a single bale of cotton. The dis-

tressed cotton which is being forced on the market comes from merchants who are selling last year's accounts.' "

The average price which will have been obtained by the South for the cotton crop of 1904–5 is probably not less than 8¾ to 9 cents a pound. As I have previously stated, this price shows to the producer a profit of probably at least 100 per cent. upon the cost of production, and yet in the face of this enormous profit an effort is being made to do what? One would naturally suppose that it would be to increase the profit through increasing the output; but no; the programme is to reduce the acreage 27½ per cent., the fertilizers from 30 to 40 per cent., and in some portions of the South it has been seriously proposed that cotton should be burned rather than sold at below ten cents a pound, while others have suggested that the boll weevil should be introduced into sections in which it has been previously unknown to the end that the production of cotton might be reduced and the price enhanced.

In the egotism of our Western civilization such methods of economic retrogation have been previously characterized as "Chinese," but certainly nothing that the Chinese have ever attempted has equalled in economical absurdity the programme that is now suggested.

During the twelve years ending September 1, 1902, the average price of middling cotton in New York was 7.69 cents, probably the equivalent of about 8 cents per lb. in the South. During the fourteen years ending December 31, 1904, the assessed valuation of property in the Southern States increased $1,686,000,000, and as far as any available statistics afford an indication, there is no single year since the war in which, irrespective of the price of cotton, its most important product, the South has not grown richer. This would seem to be rather strong corroborative evidence of the claim that even at 5 cents a lb. there is a profit in the production of cotton. The area at present is devoted to its cultivation in the cotton states is about 30,000,000 acres. The total area of the cotton states is 303,241,000 acres, of which

possibly one-half, or 151,620,500 acres is probably available for cotton culture.

An abundance of cotton would be a boom to civilization. Of the total American cotton crop some four million bales, or over 40 per cent., are consumed in America and our manufacturers have as yet hardly made an impression upon the foreign markets. In 1904 we exported $22,500,000 worth of cotton manufactures of all sorts, and we imported $49,500,000. We grow three-fourths of the cotton in the world and yet we import twice as much manufactured cotton as we export. The total exportations from all countries of cotton manufactures is $653,000,000, of which we export a beggarly $22,500,000.

It is evident that most of all the United States would be benefited by lower prices for cotton and yet the fixed purpose of those who produce it is to enhance the price and to decrease the production. As a man of Southern parentage and a close student of economic progression, I have been greatly at a loss to understand the persistence of the South in the advocacy of this economical suicide. Reluctant as I am to admit it, I can only conclude that it is in a great measure a survival of the same spirit that led to a war for the maintenance of slavery, as the attempted maintenance of slavery was in itself the outgrowth of the idea that the tenure of the cotton monopoly depended upon the legal right to enslave the negro. It required a war which cost more than the entire value of the slaves in dispute to dissipate the former fallacy, and from the intensity of feeling which has been aroused throughout the South because of a decline in cotton to seven cents a pound, an economic struggle, which has cost the South dearly this year and promises to cost it still more dearly next year, has been precipitated. It is well in such a situation to remind our Southern friends that combination in behalf of exorbitant profits has always provoked counter combination on the part of those whom it was sought to mulct, and it is to be hoped that the present issue will not be so far extended as to precipitate such a contest. If it is, the forces of progress and of sanity wlll end in the prevail, and the attempt which is being

made to check the progress of industrial development in the cotton trade will result only in loss to its authors.

The cotton crop of the United States is probably less carefully cultivated and more wastefully handled than any other of our great staples. It is estimated by the closest students of the subject that intelligent methods of culture, picking and transportation would effect an economy of not less than 20 per cent., or probably not less than one cent a pound. The experiments conducted by the United States Government in the season of 1896–7 at its experimental farms at Auburn, Ala., Fayetteville, Ark., and Experiment, Ga., showed that cotton can be produced at a net cost of less than three cents a pound. If the South could be brought to realize, and in time it will be brought to realize, that its true policy is to decrease the cost of its production, and by so doing increase the demand for that production, a new era of prosperity will dawn for both the manufacturer and the planter, and the antagonism which is now assumed to exist between them will disappear in a community of interest which will enable them jointly to command the trade of an increasing civilization whose practically stationary consumption of cotton is almost the only unprosperous characteristic of an era of otherwise wonderful prosperity.

This is what I have written. Since writing it, and while sitting here today I have heard the suggestion of your President, and his invitation to members to put before the Association any ideas they might consider practicable for the purpose of increasing the scope, influence and power of the Association — the idea has occurred to me which in a very few words I am going to take the liberty of suggesting.

I am not a cotton spinner but a cotton merchant, — or a speculator, if you like — and I am in touch with pretty nearly all sides of the business of handling the raw cotton. I am more or less (I regret it is the less) in touch with the manufacturing element; and as I sat here it seemed to me there was a necessity for some machinery in the cotton trade that should adjudicate disputes between the spinners who buy cotton and the

shippers who sell it, without delay and in an equitable manner.

I heard last night in Boston of the troubles that have beset a great many of the mills this year in connection with shipments of Southern cotton, — inability to get reclamations on it, the arrangements they had contracted for, and all the other troubles connected with business with the Southerner, who carries on business in a slipshod way; and if the New England manufacturers were to organize a set of rules — a tribunal for adjudication of such disputes, and invite the cotton spinners to join it as associate members, or some such relationship, and thereafter as soon as practicable limit the members of the association to a little cotton exchange, in which members would on penalty of expulsion or discipline be held to the performance of all contracts entered into with respect to the Southern shipper, and per contra, and so secure an equitable adjustment of any fault either in the contract itself, or in the weight or quality of the cotton agreed to be shipped.

I make the suggestion with diffidence in the presence of this large attendance, but it would create a closer community of interest between consumer and producer, and the benefits of this association would be greatly extended. I submit it for your consideration.

The PRESIDENT. We will proceed to the next paper, or rather, the paper of Mr. DANIEL MOORE BATES of Wilmington, Delaware.

GRAY GOODS FOR CLAY FILLED WORK.

DANIEL MOORE BATES, Wilmington, Del.

Clay filled goods have three principal uses. They are used for bags for salt, flour, etc.; for window shades; for sign cloths. To whichever use they are put, in no case do they go direct from the bleacher to the final consumer; in other words, they are "raw material" when they are received by the bag manufacturer, the shade maker, the sign painter. It is the object of this paper to trace briefly the special requirements of these three trades on their bleached goods in so far as these requirements are affected by the gray cloth.

Practically all of this work is done on plain woven goods of comparatively low count, rarely running higher than $\frac{6}{6}\frac{4}{4}$, and on some bag work, as low as $\frac{8}{2}\frac{2}{8}$. A typical piece of goods for bag work runs about 28 inch, $\frac{4}{4}\frac{4}{4}$, 9.50 yards to the pound, and for shade and sign work 40 inch, $\frac{6}{6}\frac{8}{6}$, 6.00 yards to the pound. It is of course not to be expected that cloth of this character can be given the same care and inspection at the mill as lawns, satines, or repps; but for this very reason, it is essential that whatever attention it does get be directed to those points which most affect its final usefulness. Moreover, on work of this grade competition is very keen all along the line and the margin of profit, where it exists at all, is at best a slender one. For this all compelling reason it behooves bleacher and final manufacturer of the goods each to see to it that his "raw material" received is up to such a standard of quality that he can convert

it into his "finished product" without any expense of extra handling.

By this I mean that the bleacher must receive gray goods which are sufficiently uniform in spinning and weaving to enable him to fill them satisfactorily *at a price*; that the final manufacturer, the bag or shade or sign maker, must receive goods sufficiently well filled, strong and free from imperfections to enable him to deliver satisfactory bags or shades or signs to his customer *at a price*. This price is fixed. It is close cut. Any extra expense incurred in getting this final standard product means loss somewhere, and this loss can be avoided only by each participant in the final product receiving standard "raw material" and turning out standard "finished goods."

These remarks apply with special force to

BAG WORK

from which, whatever the handsome dividends accruing to our confréres, the weaver and the bag maker, it is a lucky bleacher who gets back a new dollar for an old one!

The two essentials of a bag for salt or flour are that it shall be strong and non-porous, that is, it must not "bust" when stuffed fat and full, and it must not let its contents sift out through holes in the cloth. Competition demands a cheap bag, hence low count clay filled goods are used in place of high count unfilled cloth, clay being cheaper than cotton. Now it is just on these points that the selection of the proper construction for the gray goods depends. The lighter the weight of the yarns and the lower the count of the cloth, the less the cost of gray goods, but at the same time the less the strength of the finished bag and the greater the expense of clay filling it. Sufficient twist for strength in the yarns must also be had, but too much twist renders the yarns harsh and wiry, so that the clay filling will not penetrate nor adhere to them and the resulting finish is poor in comparison with other goods of the same weight and count.

No art of the bleacher can fill the goods beyond a certain point with one sizing. If, however, a very low count is strong enough for the use intended, it can be sufficiently filled with

clay by additional sizings. It is then for the bag manufacturer to decide whether the extra expense of finishing offsets the lower cost of gray goods. Incidentally he must take into account that the more clay and the less cotton, the more brittle are the finished goods, that is, the more liable the clay filling to break out.

Suppose then, after weighing the above *pro and con*, the bag maker settles on the construction of his gray goods, figuring his cost on a grade of cloth which in single filled bag finish furnishes a suitable bag for strength and density of clay filling. Two vital and not uncommon faults in the gray cloth will affect both of these qualities. They are

Mixed filling,
Uneven weaving.

They have the same results. The lighter weight yarn usually appearing from mixed filling or the smaller number of picks from uneven weaving due to faulty let-off and take-up motions, in either case reduce the strength of the bag and at the same time render it more porous because of the inability of the bleacher to fill it without additional work and increased expense. The reason for the latter is evident from the fact that in either case there is not so much cotton for the clay to adhere to. On such goods, where the difference in strength is not serious, the question at once arises, "Shall additional expense be put on them to bring the clay filling up to the standard, and if so, who shall bear this expense?" This question I find touched upon in a previous paper "Gray Goods from the Bleacher's and Finisher's Point of View"* from which I quote:

"Uneven weaving appears principally in the low count, cheap grade goods. Many of these are used for clay filled bag work and for cheap linings for other than clothing purposes. It is often impossible to fill such goods on account of the unevenness of the weave. Naturally we cannot expect to have these cheap goods perfect. At the same time smoothly working let-off and take-up motions on some looms would work wonders, and would curtail rather than add to the expense of

* Transactions, New England Cotton Manufacturers' Association, Vol. 66, p. 238.

manufacture. As explained above, it is impracticable to have the gray goods carefully examined at the bleachery. It is, therefore, often the case that a lot of goods is bleached and ready for sizing before the trouble with the weave is discovered. At that time it is too late to get any satisfaction out of the manufacturer, who piously washes his hands of the whole matter, being convinced that the pull on the cloth in bleach is responsible for the bad condition of things. In such a dilemma the only resource is to watch carefully for the next lot of similar goods from the same mill, and on its arrival make a thorough examination. In many instances defects in the gray cloth are found, and repeated experiences of this kind convince us that finishers are not the only ones who have their failings."

The remedy for mixed filling seems simple, a systematic handling of filling bobbins from spinning to weave room, and as far as possible the concentration and isolation of all looms on this work. For uneven weaving, a strict oversight of the let-off and take-up motions of the looms. These remedies are practicable and they cannot be neglected by mills handling this class of work.

Uniform gray width is important on all clay filled work, especially so on bags. The up-to-date bag manufacturer will insist on full finished width. His work is laid out to cut so many bags to a width. If this runs narrow, one set of bags in each cutting is thrown out, or has to be put into an odd lot of smaller size. Uniformity of finished width being dependent on uniformity of gray width, the mill man must see that the tension on his looms is uniform and that there is no mixture of widths in baling goods for shipment.

SHADE GOODS.

This work differs essentially from bag work in two points.

First, a better average grade of cloth, a higher count, heavier weight fabric is used, which removes the work from the "ragged edge" as to questions of clay filling and of strength.

Second, the final finished product, being used against the light, must be very uniform in texture. Light colored shadings transmit some light and these, especially, show up any defects very clearly; while dark colored, opaque shades must be free

from even the smallest weave-holes, through which the light strikes in fiery little pin points.

Briefly, the clay filled cloth from the bleachery is first run by the shade manufacturer through a thin glue solution which prepares its surface for the subsequent painting in colors. On emerging from the solution, the cloth is drawn against brushes which remove the surplus glue, and then on to a frame, where it is held by pins or clips along the selvedges, to be stretched and dried. Here the goods are drawn out often two inches or more to their original gray width. While I am not conversant with the details of shade making, I want to bring this particular point of hard stretching on the frames to your attention, for it will be evident to you that whatever defects in the way of holes are already in the goods, no matter what their cause or how much they are covered up by the clay filling, they will here be opened up, and no effort of the shade maker later in the painting can cover them.

This brings us to one of the principal defects found in gray goods for shade purposes, namely

Holes from weaving.

These largely come from three things:

Slubby, or lumpy filling yarns, where the lump of unspun cotton pulls off before the shades are finished (or, if not, leaves an unsightly lump on the face of the finished goods).

Broken warps which, in piecing-up, are drawn by the weaver under adjoining warp threads. These when woven in with the filling draw the mesh of the cloth open.

A rough sand-roll on the loom. The trouble caused by the last named is thus explained in a previous paper "Gray Goods for White Lawn Work."*

"A defect from weaving which is largely magnified by the framing, though it does not cause breakdowns, is a small hole, sometimes only one broken thread, repeating regularly through the piece twenty-one to twenty-three inches apart and at a fixed distance from the selvedge. These holes are made by a rough place on the sand-roll of the loom as

* Transactions, New England Cotton Manufacturers' Association, Vol. 74, p. 230.

it winds up the cloth. "Sand-rolls" made of tin with a cullender surface are particularly apt to make them."

Shade goods and lawns bear this relation, that before they reach their final form they are both run on frames and subjected to very heavy tension in width, which opens up the smallest holes. On bag work these very small holes are not so serious, as there is no framing of the goods after they are filled with clay.

Long, hanging threads on the face of the cloth cause considerable trouble on shade goods, bunching up in the clay filling and making dark lines, or, if then picked off, leaving a light line where the clay is removed with them. *Kinky filling, snarly ends* from a spent bobbin, and *half picks* are also very objectionable.

In suggesting how to overcome defects, I have but to recall your attention to the cardinal points of difference between bag and shade work already mentioned. At once it is seen, that while the successful weaving of bag goods demands first and foremost system and method in laying out and handling the work, the *sine qua non* of shade cloths is good individual weavers. The weaver should remove all long ends when piecing-up a broken warp, first placing his forefinger on the warp end to hold it down straight with the weave until it is fastened by the new filling. He should not draw it under adjoining warp threads across the weave to save time. He should also see that no ends of filling, half picks, are left in the cloth on changing the shuttle. If Northrop looms are used, they should be equipped with the new "feeler" device which changes the bobbin before the filling runs out. Since the advent of the Fall River strike, which by the way opened up a number of new sources of supply for the bag and shade trades, we have finished shade goods from a Southern mill, which are excellent in every way except for snarly filling ends and small weave-holes. I understand these goods are woven on Northrop looms without the feeler device. With this improvement and with a little more care on the part of the weaver, or perhaps not quite so many looms for each weaver to run, the goods should be beyond

criticism. Hanging threads which do not get snarled or tangled into the cloth on the loom, can be readily picked off by the inspector in the cloth room, or removed by a shearing machine, but in no case should they be sent out in the gray goods.

Since the smallest defects in shade goods show up in their use against the light, everything which contributes to the uniformity of the cloth adds directly to the excellence of the finished product; and in this connection too much stress cannot be laid upon the need of good spinning, of good level yarns free from *lumps* and *heavy places*, and free, also, from *oily threads* which will not bleach out. Any *heavy, irregular warp threads running through the piece* are particularly bad and should be looked out for in the beaming. While a slight variation in the number of picks is not so noticeable as in the lower count bag work, any irregularity in the let-off and take-up motions which causes *heavy bars of filling yarns across the piece* is distinctly injurious. Be careful, too, to prevent *cam-spatters* and other oil spots in weaving; but above all things, to keep up a standard of excellence in this work, have your yarns spun level and your weavers good individually.

As regards the bleacher's handling of shade work, nothing is more desirable than good selvedges, not only for the proper singeing and bleaching, but also for the subsequent clay filling. The *desirable selvedge is strong, but not wide or heavy.* Otherwise, on heavier filled work the selvedges become too thick when sized, "pile up" on the ends of the rolls, and are likely to break in running through the machines. When this happens it makes short lengths, or if the breaks are too slight to cut out, renders the goods difficult to handle on the shade maker's frames. As most of these frames are built to take sixty yard lengths, it is desirable to have the gray lengths for shade goods uniform, in multiples of sixty yards or thereabouts, to avoid waste of time in framing shorter pieces.

SIGN CLOTH.

It is often said that the happiest nations have the least history, no wars, no tumults, no troubles, nothing "interesting" to write

about them. So with sign cloth in the clay filled work of the finishing business. Being mostly of about the same grade of cloth as shade goods they, too, are largely removed from the "ragged edge" of trouble with the clay filling. But unlike shades they are not held up against the searching eyes of the sun which seek out each little irregularity. Nor are they, so far as the writer knows, put through the trying ordeal of framing, where the severe tension overlooks no hole nor point of weakness. Therefore it will be seen at once that many imperfections which in shades and bags would be serious, will be covered up in finishing, never again to appear. Small variations in count, heavy bars of filling yarns, thick threads, and to a certain extent oily yarn and spots will all be forgotten under the gaily colored signs as they hang on tree, barn and fence throughout the land; but lumps in filling yarn, hanging threads, large weave-holes, anything which impairs the surface for painting and finish are objectionable. Moreover, the selvedges should be made as explained for shade goods, and the width should be woven full and uniform, so that the sign painter may not come short in cutting out his signs any more than the bag maker in cutting out his bags. Sign cloth is a comparatively new business, but a growing one, and one very pleasant to handle. With any sort of reasonable care, the mill man should be able to weave goods satisfactory for it.

In the foregoing I have endeavored to cover those points only which apply with special force to the three kinds of work mentioned. I have purposely avoided general points such as details of baling and of mill oil, short lengths, "blind ends," etc., as these are all covered in previous papers to which I would refer you. If the cloth comes up to all these general requirements, it is none too good for the purposes mentioned, but my one idea in writing this paper is to show the man weaving for the shade trade where to direct his energies, or him turning out bag goods where to look for trouble. And I would finally impress upon you this one fact, that with full allowance for high grade work requiring and meriting more careful attention, low

grade work, especially bag work, gets much less than it deserves; that the cheapest way of turning out cheap work is to do it well; that only in this way can such work be done on a satisfactory and paying basis.

The PRESIDENT. This is not the first time that Mr. BATES has prepared a paper for this Association, and it is to be hoped that the members will show their appreciation of his efforts by entering into some discussion of the very thorough paper that we have just listened to. Will any member open the discussion; or does any member desire to ask Mr. BATES any question? (No response.)

I beg to announce that Mr. PHILIP DANA of Westbrook, Maine, has just arrived, and will be glad to answer any questions that may be put to him regarding his paper on Static Electricity Neutralized, which was read by the Secretary this morning. (No discussion.)

Then we will pass to the next paper by Mr. STEPHEN E. SMITH, of Lowell, Mass.

EXPERIMENTS IN THE MANUFACTURE OF COTTON YARN.

STEPHEN E. SMITH, Lowell, Mass.

It is not my intention to attempt to instruct the members of this Association in the art of spinning cotton yarn, but to present the results of a few of the experiments which we have tried at the Lowell Textile School, hoping that they may prove in some degree interesting.

In addition to the regular work of tearing down, resetting, changing and operating the various machines, each student has an opportunity to work out for himself any problem in which he may be specially interested and at the same time learn the results of all the tests made by other students. This sort of experimental work comprises a part of the last year of the course, and while no one of sound common sense would attempt to apply the facts found in this way to the industry in general, a large number of important points are brought to the attention of the student in a way which impresses them upon his mind much more clearly and for a longer time than could otherwise be accomplished.

A complete list of the experiments would be out of place in this paper. Among them, however, are several tests upon the metallic drawing roll to determine a proper allowance to make in figuring the draft of the drawing frame. This experiment, although tried several times, has yielded a diversity of results, the proper allowance depending somewhat upon the weight and density of the slivers going in at the back of the machine.

While the two different types of roll in use give widely different results, there has always been quite a variation in the results obtained from the same rolls. This is due partially to the fact that the slivers drawn were not alike and partly to the fact that the tests were made by different classes of students. A comparison of the work done by two different types of combers tried by one of our students brought out no startling results and a trial of hard, medium and soft twists in roving produced no extraordinary differences in the strength of the yarn as is claimed by some spinners.

An attempt was made in one experiment to show how much the quality of a yarn, as regards evenness and strength depends upon the amount of draft received in the fly-frames and spinning frame. It is a well known fact that in all the operations performed by hand, an increase in speed is accompanied by a decrease in the quality of work done. It is also generally known by everyone at all conversant with the manufacture of cotton yarn that extremely long drafts are accompanied by a reduction in the quality of the yarn spun. The object of our test was to show to what extent this would apply to a mechanical operation like the drawing process in the fly-frames and spinning.

Number 28 yarn was made from Upland cotton of $1\frac{1}{16}''$ staple employing three different programs of drafts and weights on the above mentioned machines. The table following shows the draft used and the numbers obtained in each case.

PROGRAMS.

	Long draft.	Medium draft.	Short draft.
Yarn spun,	28.5	28.5	28.0
Spin draft,	12.	9.5	7.
Fine roving,	4.75 hank	6. hank	8. hank
Fine frame draft,	7.30	6.	4.66
Inter. roving,	1.30 hank	2. hank	3.41 hank
Inter. draft,	6.25	5.	3.57
Slubber roving,	.416 hank	.80 hank	1.91 hank
Slubber draft,	5.	4.32	3.21
Drawing sliver,	100 grs.	45 grs.	14 grs.

The great range in the drawing slivers was obtained by different doublings at the back of the drawing frame together with slight alterations in the draft of the same machine. This gives the heavy sliver an advantage over the others in the number of doublings used in its production. In running the different samples the conditions with the exception of the draft were the same, the standard twist multiple of 1.2 being used for the roving and 4.75 for the yarn. In determining the strength of the yarn, one hundred skeins of 120 yards each were broken upon a power tester and the following table giving the averages shows the results at a glance.

	Average No. Yarn	Breaking Strength in Pounds.	Range of Numbers.
Short draft,	28.	59.13	26.31—28.85
Medium draft,	28.5	55.83	26.31—31.15
Long "	28.5	46.86	24.09—30.30

An examination of the yarns wound upon black card board showed very plainly the superiority in evenness of the yarn made with short drafts. The increase in strength over the sample made with long drafts is 26 per cent. for the short and 19 for the medium draft. This test shows a considerable gain in evenness and strength for the short draft and in order to prevent a misconception of these facts in the student mind it became necessary to point out the disadvantages of short drafts in the way of decreased production and greater amount of preparatory machinery required, increase in number of operatives, floor space, etc., which is wholly unnecessary to an audience of this character. This was accomplished by working out a problem showing the number of fly-frame spindles necessary in each program to produce roving for a given production of yarn.

The carding process by reason of its prominence in the manufacture of yarn has formed a basis for several interesting experiments. In one of these four different settings of the flats of the revolving flat card were tried to show which setting would produce the best yarn with the least waste. The method generally adopted is to set the flats at the back of the card slightly

farther from the cylinder than those at the front, in this way spreading the work of carding more evenly over the entire flat surface. Our experiment comprised four different settings of the flats and the table given shows what settings were used at the five points on the flexible bend.

FLAT SETTINGS.

Front	First Quarter	Center	Third Quarter	Back
Very .007 in. close,	Med. .007 in. close,	.007 in. close,	.007 in. loose,	.007 in. loose.
.009 "	.009 "	.009 "	.009 "	.009 "
.011 "	.011 "	.011 "	.011 "	.011 "
.006 "	.007 "	.008 "	.010 in. close,	.012 in. close.

In three of these settings the usual method of setting closer at the front than back was followed out while in the last case this idea was carried to an extreme and the setting at the back made twice as wide as that at the front. The different lots of cotton were afterward made into yarn each receiving the same treatment, in fact it might be called identical as they were run through the drawing and roving machinery together.

The table following shows the results of the carding process as regards amount of flat strippings made and also the strength of a 120 yard skein of the yarn.

WASTE AND BREAKING STRENGTH.

Flat setting,	.011 inch,	.009 inch,	.007 inch,	.006 inch, — 12 inch.
Per cent. waste,	2.07 "	2.19 "	2.42 "	2.20 "
No. Yarn spun,	27.4 "	27.7 "	26.3 "	27.7 "
Breaking strength,	62.51 lbs.	62.1 lbs.	61.6 lbs.	65. lbs.

The aim of carders is to remove the greatest amount of short fibres and waste with as few long fibres as possible, and it is known that a close setting of the flats will produce more waste, other conditions being alike.

In our tests the conditions outside of the flat setting were the same and as would be expected the .007 inch setting produced a stripping containing considerably more long staple than the

.011 inches while the .006 inches, — .012 inches and the .009 inches setting were nearly alike, the .009 inches stripping if anything containing more long fibre.

It would seem that the sample from which the greatest amount of waste had been removed would make the strongest yarn as it ought to contain the highest percentage of long fibre.

The results obtained by breaking one hundred skeins of each of these samples do not entirely uphold this theory and as they all received the same treatment in the subsequent processes, the carding alone would seem to be responsible.

It appears that, with the very close setting of the flats, the machine not only removes much good fibre, but by the severity of its action strains or ruptures some of the cotton passing through thus producing a weaker yarn. It is claimed by many carders, that by the times the flats have reached a point over the cylinder centre, they are so loaded with waste as to prohibit any further accumulation for the remainder of their journey. If this is the case (and it is not improbable) then by setting the flats at the back much wider than the front, a more even distribution of the work of carding would be obtained and at the same time the quality of the yarn increased by reducing the severity of the process. As shown in the table, the cotton carded in this way produced the strongest yarn which seems in itself sufficient argument in favor of this method.

Without wearying you with more details, I will merely mention briefly some of the experiments now going on. The number of doublings in a program, as every one knows, affects very materially the evenness and strength of the finished yarn. Theoretically, by doubling two or more strands at the back of any machine, a more even product is obtained because a heavy and light place in the strand enter the machine together thus tending to produce a more even sliver, roving or yarn at the front.

Of course, it is equally possible that two thick or two thin places enter at the same time, but the results in additional evenness and strength obtained by doubling goes to show that the former condition holds good in a majority of cases. We have

under way at present an experiment showing the difference in evenness and strength between five samples, ranging on one hand from a yarn made with no doublings whatever to one made with 27,648 doublings.

Another test now going on is one attempting to show something of the contraction in cotton yarn due to the twist. It is very apparent that the contraction in any yarn is governed to some extent by the way in which it is handled, tension during spinning, spooling, etc. We have carefully selected a traveller which is neither heavy enough to chafe the yarn upon the top of the empty bobbin nor light enough to allow it to thrash against the separator blades when the bobbin is full. By comparing a carefully figured draft with the draft found by weighings, we are hopeful of getting some satisfactory data for the contraction in yarn due to twist. This would probably vary somewhat according to the number of yarn and other conditions outside of the twist so that a complete set of figures could be obtained only by making several sizes of yarn.

One of our young men being interested in the handling of cotton dyed in the raw state is making into yarn, two lots of cotton, one red and one blue and a third lot of bleached stock. It was rather interesting to note the difference between the lots running on the drawing frame. While the blue and bleached gave very little trouble, the red was continually breaking down, and as they were all three drawn at the same time, the trouble would seem to lie with the red dye stuff.

Another student by means of a few old rolls, some cotton ties and considerable ingenuity has converted a part of our ring twister into a machine for producing fancy yarns; has made several styles of "nub" yarns in various colors and other fancy effects in ply yarns.

Still another man is comparing two ply twenty, three ply thirty, and four ply forty ($\frac{2}{20}$s, $\frac{3}{30}$s, $\frac{4}{40}$s), with a single ten to learn something of the comparative strengths; and is also making some twelve ply twenty ($\frac{12}{20}$) with different combinations of the single and ply yarns and wet and dry twists.

These few experiments show what we are interested in; and in part how we are trying to produce a class of men, who will have a thorough knowledge of cotton machinery and also the power to think and act independently in applying their general knowledge to any problems they may encounter in the work for which they are being fitted.

The PRESIDENT. We will next proceed to the paper by Mr. EBEN C. WILLEY, Mill Ventilation and Its Influences.

MILL VENTILATION AND ITS INFLUENCES.

By Eben C. Willey, Hope Mills, N. C.

The summer months are the cause of more or less anxiety to all manufacturers as the conditions surrounding the spinning of cotton cannot be as easily controlled as in the cooler months of the year, and are induced by the extreme heat and sultriness, and this is particularly noticeable, both in its effect on the operatives and the work in all cotton mills, although it may be more aggravated in some localities caused by the location of the mill or the condition of the machinery, as old or partially worn out machinery is more susceptible to atmospheric influences.

As the head of a department I always dreaded the warm weather more than I did as manager, as it brought me in closer touch with all the difficulties experienced at this time of the year, and which would not necessarily come to my notice, to the same extent as they would to me in the position of manager. The months of July and August are the most trying as the heat is usually more protracted and may extend over a period of several days or more, and as the operatives and machinery become affected by the excessive heat, the conditions which develop at such times, particularly in the carding and spinning rooms, can hardly be endured, as the cotton is readily affected by the atmospheric changes in these departments and cannot be easily controlled, for heat with extreme humidity is a detriment to good spinning.

The frictional heat generated from machinery, oil and the accumulation of unclean cotton which is found about all cotton spinning machinery, creates an unhealthy condition, making the

air foul and enervating to the operatives on a hot, oppressive day. Realizing this, I have many times been lenient when otherwise I should have been severe, had I not known the effect of a close, unventilated room on a hot day.

The conditions surrounding a cotton mill on a day like the above, can only be imagined, unless it is by those who have had to overcome the difficulties incident to the trying time which occurs during this season of the year.

Any improvement which can be secured to lessen and mitigate these conditions would be a great boon, both in the interest of the manufacturer and the contentment of the operatives. These conditions have been found to exist in some of the best mills in New England, and I have noticed in these mills on warm days in the summer, an utter lack of energy in the operatives, and a disregard of everything which would show a well disciplined department, wholly on account of the discouragement induced by the work being affected by the weather.

In this connection, I might add that it is the usual custom in all cotton mills to close the windows at night; but if many of our mill managers could realize the effect of the foul, stagnant air in their several rooms at starting time in the morning after an extremely hot, sultry day, it would seem that provision would be made for the ventilation of the carding and spinning rooms over night, as I have found this condition to exist in all mills, and the only remedy which I could apply was the free opening of the windows in the early morning. It has a salutary effect on the operatives as well as the benefit derived from the operation of machinery at this time.

While knowing these conditions existed, and realizing that something should be done, I had never thought of the best method to overcome same till the propeller fan was brought to my attention; and after a thorough trial it demonstrated its value by the improvement in the spinning of the cotton, and I have adopted them for the carding and spinning rooms wherever possible. Owing to the benefits derived by the use of fans, I have come to the conclusion that it is not so much the high

temperature or the humidity that causes the difficulty as it is the foul, stagnant air, which affects both the operatives and the work.

If the impure air can be eliminated, it results in such improved conditions that good work is usually assured, and although the day may be hot and uncomfortable on the outside, with a free circulation of air inside the mill caused by the exhausting of the foul air from the room, it would not be noticeable in so far as the work is concerned.

The whirling of machinery and pulleys does not produce a draught, but only agitates the air and does not expel it from the room, or draw in the air from the outside, and the only remedy is to exhaust the air from the room in order to secure the best results and can only be accomplished by the use of fans.

The use of humidifying machines is of great benefit, and while it would seem impossible for us to get along without them, the fan is of equal service at this time of the year and aids the machines in their distribution of moisture as well as expelling the impure air.

While the fan should be operated in the summer, it is of benefit even in winter in many spinning rooms by expelling the excessive temperature thrown off by the frictional heat from the spindles. Necessarily, the windows are kept closed in the winter and in order to be assured of pure air and wholesome conditions, the fan is the only remedy for this department.

It has always been found that water freely used on the roof of a mill in summer while cooling the upper room, also has a good effect on the air entering the windows on the lower floor; but in a mill of three or more stories in height, the greatest advantage that could be obtained would be by installing a set of spray nozzles extending same beyond jut of roof and allowing the spray to fall next to the open windows. The finer the spray, the better the results, and if used in connection with the fan it is particularly beneficial to the work and the operatives, as it draws in the moisture through the open windows.

I remember several years ago where this system was in operation

the weather during August was extremely warm and unbearable, but the carding and spinning rooms were not affected to any extent by the high temperature outside, and, excepting the debilitating influence of warm weather on the operatives, we had no trouble in our work running satisfactorily.

My experience in the South during the summer of 1904 demonstrated the value of both fan and water, for, while the temperature would rise to a high point, it would not be noticed or realized by a person on the outside owing to the air being dry and free from sultriness which is prevalent in New England. Inside the mill, however, it would become exceedingly warm, especially from 12 to 6 P. M., and during this time the air would become very foul, and continued hot weather for a week or more showed its effect on the operatives by a loss of energy and a fatigued appearance.

The introduction of the propeller fan and water remedied the difficulty and it was at once apparent in the general appearance of the operatives, they becoming more energetic, with a consequent better attention to work. Previous to the fans being installed, it was not unusual for the temperature to rise to 115 degrees by 3 P. M. and 120 degrees at 6 P. M., while the outside thermometer did not register over 96 degrees.

To show what was accomplished in a 300′ x 70′ mill by the use of propeller fan and water sprayed on the roof, I submit a table showing in detail the temperature both inside and outside the mill, which included several of the hottest days in the year, and you will note by a careful study of same, with the thermometer located in the shade, the extreme variation in the temperature from 6 A. M. to 6 P. M. You will also note the difference between the inside and outside of mill, and it seemed to me somewhat remarkable in following these tests carefully to observe the slight variation in the temperatures. Those familiar with millwork can realize what the improved conditions would accomplish by keeping the temperature at a minimum point in all carding and spinning rooms during this season of the year.

Date.	Hour. 6	8	10	12	12.45	2	4	6	Av.	Remarks.
Aug. 18.										
Inside Temp.,	90	96	99	97	98	101	102	104	98.37	*F.
Outside "	71	90	92	92	92	98	100	90	90.62	
Aug. 19.										
Inside Temp.,	86	91	96	98	98	100	102	102	96.62	†F. & W.
Outside "	70	81	83	98	88	99	98	90	89.62	
Aug. 22.										
Inside Temp.,	87	92	98	101	100	103	104	105	98.75	F. & W.
Outside "	73	89	91	98	100	100	99	98	93.50	
Aug. 23.										
Inside Temp.,	90	95	97	100	99	103	99	94	97.12	"
Outside "	78	87	90	92	93	99	91	73	87.87	Thunder Shower, 3.30 P. M.
Aug. 24.										
Inside Temp.,	87	93	96	99	95	100	101	103	96.75	F. & W.
Outside "	71	73	80	82	83	89	89	82	81.12	
Aug. 25.										
Inside Temp.,	84	92	96	99	98	100	101	101	96.37	"
Outside "	70	79	84	92	93	91	94	90	86.62	
Aug. 26.										
Inside Temp.,	87	92	95	98	96	99	98	99	95.50	"
Outside "	76	80	85	93	94	91	79	76	84.30	Thunder Shower, 4 P. M.
Aug. 29.										
Inside Temp.,	73	79	86	91	90	94	94	96	87.88	F. & W.
Outside "	59	68	76	83	85	88	88	85	79.	
Aug. 30.										
Inside Temp.,	78	85	90	94	93	96	99	99	91.75	"
Outside "	62	70	80	87	88	90	98	84	82.37	
Aug. 31.										
Inside Temp.,	84	89	92	95	94	96	98	99	93,36	"
Outside "	68	75	84	88	91	90	86	84	83.25	
Sept. 1.										
Inside Temp.,	84	89	92	95	94	96	98	99	93.36	"
Outside "	68	76	81	87	88	89	89	82	82.50	
Sept. 2.										
Inside Temp.,	86	90	95	97	96	99	100	101	95.50	"
Outside "	71	78	86	92	93	94	94	86	86.75	
Sept. 5.										
Inside Temp.,	95	91	94	98	97	95	95	96	95.	"
Outside "	73	77	84	86	84	82	76	72	79.25	
Sept. 6.										
Inside Temp.,	82	86	87	88	87	91	94	94	88.92	"
Outside "	68	72	75	79	81	80	80	65	76.37	
Sept. 7.										
Inside Temp.,	84	88	92	94	94	98	99	99	93.62	F. & W.
Outside "	68	75	84	88	91	96	86	84	84.	

Sept. 8.										
Inside Temp.,	84	89	92	95	94	96	98	99	93.37	F. & W.
Outside "	68	76	81	87	88	89	89	82	82.50	
Sept. 9.										
Inside Temp.,	86	90	95	97	96	99	100	101	95.50	"
Outside "	71	78	86	92	93	94	94	86	86.75	
Sept. 19.										
Inside Temp.,	73	78	85	92	92	95	98	98	88.88	"
Outside "	58	66	78	83	84	85	88	80	77.75	
Sept. 20.										
Inside Temp.,	81	85	90	93	92	96	97	99	91.62	"
Ousside "	65	73	84	86	87	89	89	83	82.	
Sept. 21.										
Inside Temp.,	86	87	88	88	87	86	88	93	87.88	
Outside "	68	77	80	79	78	73	71	70	74.50	
Sept. 22.										
Inside Temp.,	73	78	83	87	86	88	91	80	84.75	
Outside "	53	57	64	68	68	70	66	63	63.62	
Sept. 23.										
Inside Temp.,	70	76	80	86	86	91	93	94	84.50	
Outside "	46	52	60	66	68	70	70	64	62.	
Sept. 26.										
Inside Temp.,	78	81	89	93	92	95	98	97	90.37	F.
Outside "	60	69	79	85	86	87	88	82	79.50	
Sept. 27.										
Inside Temp.,	80	86	93	97	96	97	98	99	93.25	F. & W.
Outside "	63	72	82	87	90	91	90	84	82.37	
Sept. 28.										
Inside Temp.,	85	87	92	95	95	98	99	99	93.75	"
Outside "	65	72	83	89	90	90	91	84	83.	
Sept. 29.										
Inside Temp.,	85	90	93	97	96	99	99	100	94.87	"
Outside "	73	76	81	87	88	89	88	85	83.37	
Sept. 30.										
Inside Temp.,	87	89	92	94	94	96	97	99	93.50	"
Outside "	70	78	89	91	93	92	92	80	85.62	
Oct. 3.										
Inside Temp.,	74	80	84	84	90	90	91	95	85.62	F.
Outside "	53	62	68	76	76	77	77	70	69.87	
Oct. 4.										
Inside Temp.,	75	80	83	86	86	90	92	93	85.62	"
Outside "	48	58	66	70	72	74	74	76	67.25	
Oct. 5.										
Inside Temp.,	78	78	83	87	86	88	92	94	85.75	F.
Outside "	47	51	66	72	74	75	76	72	66.62	

Oct. 6.										
Inside Temp.,	74	80	86	89	89	91	89	92	86.25	F.
Outside "	57	62	75	82	83	84	78	72	74.12	"
Oct. 7.										
Inside Temp.,	75	79	79	83	81	86	89	91	82.87	"
Outside "	55	54	58	61	62	63	64	60	59.62	

*F.—Fan in operation.
†W—Water in operation.
When either of these letters do not appear it means that the same was not in operation.

Mr. EBEN C. WILLEY. I might add in closing that the table which follows the paper, the list of temperatures, I would like to call to your particular attention, and have you note the changes in one particular, namely, August 18, when at 6 o'clock in the morning the temperature was 71, and at 8 o'clock it was 90; and that we found a similar variation in the afternoon, particularly after a thunder shower, when the temperature would sometimes drop 20°.

The PRESIDENT. Mr. WILLEY is also one of our members who has addressed the Association upon more than one occasion, and it would seem at least graceful on the part of some member to continue the discussion. (No response.)

Evidently there is no discussion desired, gentlemen, and this is the last business of the afternoon we will adjourn until ten o'clock tomorrow morning.

Adjourned at 3.45 o'clock.

THIRD SESSION.

THURSDAY MORNING, APRIL 27, 1905.

The Association met in Chipman Hall at 10 A. M., President WALMSLEY in the chair.

The PRESIDENT. Gentlemen will you please come to order, and I will call on Mr. JOHN W. NASMITH of Manchester, England for his paper on Analysis of the Detaching and Piecing Processes in Combing Machines.

Mr. JOHN W. NASMITH. Mr. President and Gentlemen: One of the pleasantest things in your Association appears to me to be the cordial invitation which it extends to the foreigner, but I have some difficulty in this Association in thinking myself a foreigner, and have availed myself with much avidity of this opportunity.

I do not think I need take you through this paper, which is somewhat lengthy, verbatim; I will, therefore, just choose one or two of the points worthy of emphasis, and call your attention specially to them. In the first place I would invite your attention to the illustration on page 184.

CRITICAL ANALYSIS OF THE DETACHING AND PIECING PROCESSES IN COMBING MACHINES.

JOHN W. NASMITH, 33 Barton Arcade, Manchester, England.

It may seem to many, that such a machine as the Heilmann Comber, which in its day revolutionized fine spinning and has enjoyed the favor of the fine spinners throughout the world for more than half a century, is above criticism. Yet in these searching times, even long standing service does not exempt either men or machines from critical investigation of their actions and it is perhaps well that such examination should take place from time to time.

It is proposed in the present paper to examine analytically the detaching process in combing machines and its bearing on production, the piecing and its influence on the yarn and sliver and the theoretical considerations that have to be taken into account with reference to the amount and quality of waste taken out of the cotton in the combing process.

It is doubtful if any machine will ever be invented, that will comb cleaner than a well-made Heilmann machine, for its work in this respect is almost perfect. But in other respects its performances are not quite so satisfactory.

In Heilmann's French Patent, dated Dec. 17, 1845, he gives a most interesting descriptive memoir, which contains, not only a precise statement of the principles underlying the combing of all fibrous materials, but shows a variety of ingenious and original mechanical devices whereby the principles may be carried into

effect and he formulates his object and aim in the following sentence: —

"It will be seen from the demonstration, that it is proposed to separate, from a lap, a series of tufts, which being combed throughout their entire length, are to be reunited again into a sliver and all this by entirely automatic means."

That is, in few words, a precise description of what happens in all combers, but it must be noted that nothing is said about the *regularity* of the sliver built up of the reunited tufts and yet this is a most important point. The introduction of the words "perfectly regular" before sliver" would complete the description. But the production of a "perfectly regular sliver," in the strict sense, is what no Heilmann comber has as yet accomplished, nor is it likely that it ever will. Certainly the resulting sliver is within the domain of practice, otherwise the machine could not have survived, but even this is questionable when the staple to be dealt with is only one inch long or less. No doubt in Heilmann's time, the combing of such cottons was never considered.

Everyone using combers, is familiar with the cloudy appearance of the Heilmann sliver as it leaves the draw-box of the comber and this cloudiness is still visible even when combing the longest cottons and becomes more and more conspicuous, the shorter the staple used. It arises from the shortness of the overlap of the tufts when reunited.

Figure 1* shows two slivers of the same cotton (1¼ inches Egyptian). The one marked *H* is from the front roller of a Heilmann draw box and that marked *N* from that of a Nasmith comber. It should in fairness be remarked, that the draw-box of the latter has four lines of rolls compared with only three in the former. But the addition of a fourth line will not make irregular slivers into regular ones, it only facilitates a higher draft. It is hardly necessary in the presence of practical men to labor the question as to which of these two slivers will make the evenest yarn. In the subsequent drawing processes,

* In accordance with the wishes of the author, the illustrations are omitted.
Secretary.

the cloudiness is lost to sight and its injurious effect mitigated by frequent doublings, but although invisible its presence is undeniable and it is only extended over a greater length. The unevenness of the Heilmann sliver is the worst kind of irregularity to deal with, as the variation is great in very short lengths. A variation, even a great one, that extends over say three yard lengths, soon loses itself by doubling and drawing and a fair average yarn is the result. But the variation in yarn caused by large variations in very short lengths is not discovered by the usual methods of testing either in the yarn or in the sliver. For instance, a sliver may vary enormously from inch to inch and yet show no abnormal variation when weighed in three yard lengths. The yarn, however, shows it in strength and in appearance, but more especially when tested on an automatic MOSCROP yarn tester, which tests the single thread in definite lengths of about twelve inches.

The manner in which the Heilmann comber detaches the tuft, combs the tail by the top comb and makes the piecing and separation, may now be examined as briefly as possible and reference to the figures 3 to 7 will assist the description and help to make it clear.

The forward motion of the detaching rollers may be divided into THREE PERIODS. (1) The starting up of the rollers to full speed. (2) Rotation at full speed during the time the leather roll *L* is in contact with the fluted segment and (3) bringing the rollers to a stand still, after this contact has ceased.

In figure 3, the rollers *R* and *L*, after turning backwards are just beginning to revolve in the direction of the arrows. Now, the leather covering of the leather roller *L* is rapidly deteriorated, or even destroyed, if it is allowed to come in contact with the fluted segment before it has acquired the same surface speed as the cylinder and the following considerations will show why it is not practicable to construct a durable cam that will overcome the inertia of the rollers and get them up to the required speed in less than one sixth of their revolution. Let it be assumed, that the speed of the comber is 100 beats per minute. During

$\frac{22}{40}$ of each of these 100 beats the rollers are stationary, during the remaining $\frac{18}{40}$ or in less than half a revolution of the cylinder, that is, 0.075 of a second, at 100 beats, they must perform the following evolutions. They must start backwards and stop, then start forward, attain a speed of 530 revolutions per minute for the roller *L* and 480 for the steel roller, maintain this during 34 degrees of a revolution of the cylinder and then come to a standstill. Hence the roller must start gradually and the important point to notice is, that in doing so, it takes forward 0.47 inches of the tail (seen depending in figure 3,) on which the piecing is to be made, before the detaching operation commences, and brings it to the position shown in figure 4, when it measures barely three-fourths of an inch in length. At this point the leather roll *L*, moving at the same surface speed as the cylinder, comes in contact with the fluted segment and snatches a tuft from the end of the lap through the top comb. The sudden jerk and tension put on the fibres is better imagined than described. It is to be further observed, that the tuft is not seized by the extreme tips but about $\frac{3}{8}$ of an inch from the end, right in the body of the lap where it offers the greatest resistance to drawing. These two facts limit the production of the Heilmann comber, for if a heavy lap be used, the leather roll, driven by friction only, is incapable of pulling so much material through the top comb in so short a time and simply stops. If greater weights be applied, the roller deflects especially on the wide machines and long waste is made in the middle of the lap.

When the roller *L* comes in contact with the fluted segment, it seizes and draws forward every fibre nipped, but every one of those whose tips just fail to reach the nip (line *a* figure 4) remain in the lap end. It is, therefore, obvious that the length of the detached tuft can never exceed the length of the staple used plus the length projecting to the left, beyond the nip of the roller on the segment, which measures from $\frac{3}{8}$ inch to $\frac{1}{2}$ inch, ($\frac{3}{8}$ inch will be taken for the purpose of this investigation) Thus for 1$\frac{1}{4}$ inch cotton, the greatest possible length of the

detached tuft is 1¾ inches, a maximum rarely reached, 1⅝ inches being the usual limit. On this short tuft (figure 7,) two piecings have to be made, one before and one behind and from what has preceded, it is obvious, that an overlap of more than ¾ of an inch is not possible. In practice, with 1¼ inch cotton this maximum is never reached, and if it were, it is still much less than the distance from centre to centre of the draw-box rollers. Hence arises the cloudy sliver previously referred to and seen in the first illustration. It may be here remarked, that in the early days of combing, the backward motion of the detaching rollers was just half the forward motion. The piecing was much improved by Mr. JOHN HETHERINGTON'S patent of 1869, when the backward motion was increased as much as possible and the overlap carried to the utmost limit possible on a Heilmann comber.

THE SEPARATION may now be examined. Between the positions shown in figures 4 and 5, (the second period or time of contact) the segment revolves through 34 degrees, corresponding to 1¼ inches of its periphery, this length passing below the roller *L*. It is just sufficient to pull the fibres, whose extreme tips are nipped by roll and segment at the line *a*, through the top comb, but is insufficient to complete the separation, which is done from the nip between roll and roll (*c*, figure 5). The minimum distance between this nip and the top comb is clearly $\frac{d\pi}{4} + \frac{d}{2} + \frac{1}{8} = 1\frac{3}{16}''$ nearly; *d*, the diam: of the roll *L*, being $\frac{3}{16}$ of an inch. But many fibres pulled forward by the contact of roller and segment are shorter than this and do not reach to the nip between roller and roller and are not clear of the lap end just in front of the top comb, where they are retained by friction with their fellows, tightly wedged in the comb and are inevitably carried into the waste by the next passage of the cylinder needles, since they are not held by the nipper. This is the frequent source of the long fibres found in the waste of Heilmann combers and explains why it is impossible to comb short cottons on the Heilmann, except with excessive

waste, which is of course, the chief factor in the cost of combing.

Since the roller L whilst in contact with the segment must maintain the same surface speed, it cannot be left longer in contact without shortening the third period, during which the system of rolls has to be brought to a standstill and a durable cam cannot be made that will check the momentum and stop the rolls in less time than at present. To increase the amount of the forward revolution, entailing, as it does, a corresponding increase in the backward rotation is seen to be also impracticable so long as the total length of the detached tuft is only 1⅝ inches and the overlap ⅝ of an inch. This short overlap is insufficient to retain the hanging tuft, if it is allowed to depend further from the roller R than shown in figure 3, especially seeing that the overlap is merely a superposition without thorough amalgamation by drawing.

After the roller L has quitted the segment, it continues to revolve till the position figure 6 is reached, completing the separation whilst coming to a standstill. It takes the end into the rollers R and L as shown in figure 6 and there remains stationary during $\frac{23}{40}$ of a revolution of the machine. The rolls then move backwards delivering 1.45 inches to provide the end for piecing and overlap and the cycle of operations is repeated.

From the preceding observations, it appears that the detaching, piecing and separation on a Heilmann are precisely and perfectly designed to deal with detached tufts averaging 1⅝ inches long.

The question of waste may now be briefly examined. On reference to figure 6, the line y is seen to pass through the cushion plate at the point where the lap is nipped, the line x' through the nip of roller and segment and the line x through the nip of the two rolls R and L. Theoretically the length of waste on the Heilmann should equal the distance x' to y but in practice it is found to be longer, the method of making the separation accounting for this. The longest fibres exceed the length $x'y$ but are less than the distance x to y. The various methods of altering the waste need not here be referred to in

detail. There is only one sound method of doing this and that is by varying the distance x' to y, but, in a Heilmann this is a very long and laborious operation, as it involves a complete readjustment of the various motions. Expedients are then resorted to, as for instance increasing the angle of the top comb, which is a drastic method, putting considerable strain on the fibre. In effect, it increases the distance $x' y$ by compelling the lap to bend under the top comb, figure 5, instead of passing in a straight line from the cushion plate to the nip of roller and segment as seen in figure 4.

Two other points may be incidentally noticed. The cushion plate is held by strong springs in the positions shown and is compelled from this position by the descent of the top knife, which strikes it with a sharp hammering blow from 90 to 100 times per minute, necessitating a cushion of some kind to prevent damage to the cotton. Next the path described by the point of the nipper, if continued too far, intersects the periphery of the cylinder and damages the needles, a result frequently occurring by reason of neglected roller laps on the feed roller.

Having now investigated the limitations of the Heilmann comber, the detaching, piecing and separation processes in the comber with which my name is connected may be similarly examined. Its chief characteristics were outlined in a paper read before this Association by the late Mr. JOS. NASMITH, in the spring of 1902.

Reference to figures 8 to 16, will assist the explanations. The chief points to be noticed are: — (1) The fluted segment is abolished and the detaching is done by a pair of rolls. (2) The nip between the rollers is the only one used and makes both the detachment and the separation. (3) During detaching and piecing the top comb, the nipper and the axis of the feed roller are not stationary, but move towards the nip of the rollers. (4) The separation is only commenced by the revolution of the rolls, just as they are stopping and is completed by the withdrawal of the top comb and nipper, thus economizing the revolution of the rollers and saving time as well. (5) The

forward movement of the nipper and top comb permits a tuft four inches long to be detached each nip instead of only 1⅝ inches. (6) The time during which fibre is being drawn through the top comb, **Includes the Separation Time and is 3.7 Times as Long** as in the Heilmann. This is a vital point, as it explains how the high production is obtained without loss of cleaning power and may now be further elucidated. Reference to figure 12 will assist the explanation.

Suppose the end of a lap held by a top comb be presented to a pair of revolving rollers. The latter will draw off all the fibres whose tips reach into the nip of the rolls and if the top comb and lap end be moved gradually towards the rolls, the fibres whose tips lie in the spaces marked a and b will be successively seized and drawn off into a long tuft, whose length will depend on the relation between the speed of the rolls and the advance of the lap, until, when the advance ceases, the lap end is reduced to the length marked c. This is what takes place in a Nasmith comber. The nipper and the axis of the feed roller advance with the top comb, all three being carried on an oscillating frame, actuated by a crank, whose motion has the advantage of diminishing the speed of the advance as the full thickness of the lap approaches the rollers.

The forward revolution of the detaching rollers can only be divided into two periods, as they simply start up and then slow down, exactly as the piston of a steam engine under the guidance of the crank, which produces the smoothest reciprocating motion known to the engineer. There is thus no middle period, when the speed of the rolls must remain constant and there is consequently no irksome restriction in surface speed. The absence of this restriction permits the use of a smooth, quiet detaching cam for operating the rollers, which is the only cam in the Nasmith comber.

Referring to figure 8, the rolls are seen just commencing their forward rotation in the direction of the arrows. There is no danger of the long end being carried down to the waste owing to the length of the overlap and its complete amalgama-

tion with the preceeding tuft by drawing. The starting up of the rolls is much more gradual than in the Heilmann and the pluck and sudden tension put on the fibres is greatly mitigated. It will be further noticed that the lap is seized by the extreme tip, where it draws easily, thus further relieving the strain and fully two inches are still seen depending from the roller on which to make the overlap. (Figure 9.) Comparison of this with figure 4, where a tuft and overlap in excess of the actual lengths obtainable is shown, reveals the great difference in the length of overlap obtained, whilst the fibres of the new tuft are drawn into and thoroughly amalgamated with the tail, whilst in the Heilmann they are simply superposed without any tension.

If the roller *L* were to remain in the position shown in figure 9, the advancing top comb would reach the roller soon after seizure of the tip of the lap. In order to prolong the detaching process as much as possible, the roller is slowly moved away before the advancing comb until the position of figure 10 is attained. Here the top comb and nipper are practically stationary, the crank that drives them being on the dead point. The speed of rotation of the rollers *R* and *L* is decreasing, but the motion has not entirely ceased and they continue to deliver about ¾ of an inch after the top comb and nipper have reached the end of their path. This latter movement commences the separation, which is completed by the withdrawal of the comb and nipper as seen in figure 11. Between the positions shown in figures 9 and 11, the rolls have drawn off a tuft four inches long as compared with 1⅝ inches in the Heilmann, or nearly 2½ times as long, if the whole length of the respective tufts is taken into consideration. But in order to properly compare the number of fibres moving in the needles of the comb at any one instant in the two machines, the length (1 inch) of the tuft projecting beyond the comb must be deducted, reducing the lengths respectively to ⅝ of an inch and 3 inches.

On reference to figure 15, representing Heilmann conditions it is seen that only ¼ of an inch of the fibre represented by *l* lies behind the comb, whilst ⅝ of an inch of that represented

by *m* is behind it. Both these begin to move through the comb *at once* without changing their relative positions when the sudden pull, due to contact between the roller and segment, takes place. Consequently, the ⅝ of an inch remains that length in the detached tuft and is not lengthened out and the draft is therefore 1.

But in figure 16, representing the Nasmith, the fibre *l* moves *first* and changes its relative position in the detached tuft with respect to *m*, which does not begin to move forward till the detaching is almost ended and, when it does move, does so comparatively slowly, allowing the ⅝ of an inch a better chance of being cleaned without strain or risk of breakage. The ⅝ of an inch length behind the comb is drawn out to three inches, hence the draft is 4.8 to 1.

If the weight of lap and speed of the rolls were the same in both cases, the number of fibres moving in the needles of the top comb at any one instant would be 4.8 times as many in the Heilmann as in the Nasmith, but in the latter machine the lap is double the weight so there is only 2.4 times as many moving in the Heilmann.

Next comparing the speed at which the fibres pass through the top comb it is seen that ⅝ of an inch of fibre passes through the Heilmann comb whilst the cylinder revolves through 34 degrees of arc. In the Nasmith ⅝ of an inch, drawn into three inches, passes through the comb whilst the cylinder revolves through 126 degrees of arc. Consequently, in the Nasmith ⅝ of an inch of lap, double the weight of the ⅝ of an inch of Heilmann lap, passes through the comb each nip but takes 3.7 times as long to do it. From this it is clear that there are moving in the Heilmann top comb at any instant, more than double the number of fibres that are moving in the Nasmith. But the bulk of fibre sticking in and held by the comb in the latter is greater than in the former and both of these facts, the light fibres passing and the thick mass held, contribute to make cleaner work, so long as the lap is not so thick as to hinder complete penetration of the comb.

The forward motion of the Heilmann rolls is 1.08 inches in excess of the backward motion, whilst in the Nasmith it is 1.84 inches. If the latter produces double the former, this excess should be 2.16 inches to give the same thickness of fleece, but the greater relative overlap in the Nasmith takes up the difference and so the fleece looks thicker and is thicker than in a Heilmann.

The diagram figure 14 presents these results in convenient comparative form. The vertical lines represent fortieths of a revolution of the cylinder (or inches when required.) The first horizontal column compares the duration of the forward motions of the rollers. The second gives the comparative duration of the passage of fibres through the top comb. The third shows the comparative number of fibres moving in the top combs at any moment, the fourth compares the draft and the fifth the overlaps. It is seen that much of the forward motion in the Heilmann is concerned only with the separation without contributing to the length of the detached tuft. In other words, 2.53 inches of forward delivery are required in the Heilmann to deal with a 1⅝ inches tuft whilst in the Nasmith four inches suffice to take care of a four inch tuft.

It remains to show how easily the length and consequently the amount of waste can be altered in the Nasmith. Its length is invariably equal to the distance x to y (figure 10.) Two set screws, a and b, figure 2 serve to displace the whole of the nippers simultaneously, for instance from y to y' figure 10, carrying with them the top combs and feed rolls, which immediately lengthens and increases the amount of waste. No further complicated adjustments are required.

It may be further noted that the lower nipper jaw is a fixture on its framing and once set cannot be made to touch the cylinder and the closing of the nipper is very silent and gentle so that no leather covering or other cushion is needed. The smoothness of all the motions permits a speed of 100 nips almost without noise. The gratifying reception afforded to the machine by spinners all over the world is attested by the fact that since

April, 1902 to March 31, 1905, 441 machines have been made and delivered.

There is just one point not referred to in the paper, and that is the application of this machine not only to very fine work but also to what seems to be somewhat in vogue in America, the semi-combed.

Now a carding engine, is of course, not a cleaning machine, but an opening machine, though it incidentally takes out a great amount of dirt, but not in a selective way, and it does not strike the fibres in any way. You leave the doffer at the doffer comb; you cannot tell in which direction they come off the doffer. So if you look upon the card as purely an opening machine, and neglect its cleaning power, it may be, suppose you put it up to 1,200 pounds a week, you can open well but not clean it.

The high production of the Nasmith Comber enables it to comb that material as fast as a card; you can get that very low percentage of waste, and make a cleaner sliver than a card can when doing very low production. And it is a question whether it is not profitable to study a combination of these two processes, for the combing can be done with very low waste, we have combed as low as four per cent.

Of course, it is not to be compared when you are taking 15 per cent. of waste, and it takes out all the very short, fluffy fibre, and straightens the fleece so you have a sliver which is exactly combed sliver, except it is not quite so clean as you would expect in real combing, but it does not cost very much. The floor space and capital outlay and wages for combing are only small factors; it is only the waste taken out that makes combing such an expensive process; and if that can be reduced four or five per cent., and the production put up to a thousand weight, it should be possible to make that process a paying one. [Great applause.]

The PRESIDENT. I think, perhaps, gentlemen, that all practical cotton spinners will agree that in its way a comber that is capable of combing very short cotton is going to be as important a factor in the manufacture of cotton as the automatic loom is in the weave-room.

I will merely say to you, gentlemen, perhaps for your own information or interest, that in so far as this particular comber goes I can state positively that it can comb, and does comb, the very shortest cotton up to the very longest staple equally as well, with double the production that the Heilmann comber combs.

I speak from experience in the matter, for in several mills in New Bedford we have this comber. At the Wamsutta we have had them for several months, having introduced a complete set of them, and therefore, I can speak positively of the possibilities of this particular machine.

The most important point in our judgment, is that it does comb so well the very shortest fibre that you may desire to use. With a six-head comber, 10½ inch lap, this machine will do exactly a hundred per cent. more work than the Heilmann comber, six-head 9 inch lap, and I do not hesitate to say this, gentlemen, and to go on record, though I am not advocating this machine at all, it is not my province; nor would it be correct for me to do so, anyway.

I would say, however, that and in my judgment as a spinner, it is a very great advance in the processes of carding and combing. More so, in our judgment, from the fact as I say, that it does comb inch cotton perfectly; on 1¼ and 1⅛ it will do double production equally as clean, which is an important point, and far better piecing than the Heilmann comber can produce.

Now, gentlemen, I have said all I need to say about it, but I was desirous of saying this so as to invite, if possible, some discussion of the matter, which I think all practical cotton spinners will regard as of very, very great importance.

Does any gentleman desire to ask Mr. NASMITH any question regarding this comber?

Mr. O. B. PARKER. I would like to ask what length of staple was illustrated here?

Mr. JOHN W. NASMITH. One and one-fourth Egyptian cotton.

Mr. O. B. PARKER. Will one inch work?

Mr. JOHN W. NASMITH. Yes, three-fourths will over-lap equally as well.

The PRESIDENT. If there is no further discussion we will proceed to the next paper by Mr. EDWIN H. MARBLE.

Mr. EDWIN H. MARBLE. In a trade's procession in Philadelphia I was struck by an inscription reading something like this, " We have got to finish what you do not do," and it occurs to me as having an application in connection with this paper. As each mill must be equipped for its own class of goods, and as this paper has been prepared to cover in a general way, instead of taking it in full, I want to call your attention to a few points.

On the first page I have taken up the matter of weave-room inspection so called. It is not that exactly; it is rather, weave-room examination, with the primary object of discipline in the processes through which the cloth has gone. If there is a piece of goods comes to the examiner's table in poor condition, that condition should at once be brought to the attention of the one in charge of the cloth-room, and the error, no matter where it is found can be immediately corrected.

A gentleman who equipped his mill some time ago with this

method of handling cloth made the remark that he had gotten rid of two or three of his poor weavers, as they found that corrections were made at once, without waiting until after it had reached the cloth-room, or they had time to get their pay and leave the place, or had time to lay it off on to someone else. The loom fixers and designers can also be called to account.

One of the mills in New England a short time ago put an inspecting machine in their cloth room. I received a word two days after from the superintendent of the mill that he wished he had put it in eight hours sooner, as he found a line in some silk stripes which the designer had failed to place; and if it had been put on the examiner's table before, it could have been stopped. As it was it went into the seconds.

It is valuable in this way, as there is no reason for putting a piece of goods which is a second through the same processes that you would other goods.

THE CLOTH ROOM AND ITS EQUIPMENT.

EDWIN H. MARBLE, Worcester, Mass.

In these days of specializing, an attempt to describe in one paper the cloth room best adapted to meet the requirements of all makes of cotton fabrics, would be a task beyond the writer's capabilities — but we will spend a short time in examining the essential features of any cloth room, leaving the specific arrangement to the particular agent who is interested.

Prior to the actual cloth room work, we must stop a moment in the weave room and get our fabric into condition for the processes properly covered by this article. As each cut is taken from the loom, it should be examined, by drawing it over a table, preferably an inclined one; so that the examiner may readily detect any imperfect work, as well as properly classify the goods, if more than one grade is made in the same weave room. The operator should look for any irregularity in the work of the loom, inequalities in warp or filling, or more important than either of these, any carelessness or wilful neglect on the part of the weaver. In connection with the overseer of the weaving department these imperfections should be immediately attended to, and if for no other reason than the matter of discipline, the examination should be close and impartial. When the cut leaves the examiner's hands, it is marked or graded, and placed in the proper receptacle to be handled as soon as called for in the cloth room. A checking of the yardage and "seconds" is thus made, before any time elapses between the weaving and the next operation.

While this preliminary process should be introduced into all mills, each fabric requires somewhat different treatment in the cloth room. For the purpose of illustration let us take a piece of sheeting or twill as our fabric; each grade having been received in proper quantity, the individual pieces are brought to the railway sewing and rolling machine to be assembled, either into a roll or made up into a continuous length.

NO. 25. RAILWAY SEWING AND ROLLING MACHINE.

The first piece is placed in the cradle of the sewing machine, — it is unrolled from the loom bolt and either rerolled on a shell at the back, or plaited down on an endless apron. The last end of this piece is placed upon pins, in line with the sewing mechanism. The first end of the second cut is placed upon these same pins and the goods drawn smooth and tight in width. The sewing machine head is made to travel along a straight line between the pins, stitching the ends together with a continuous loop stitch, and stopping automatically at the end of the seam; the sewing machine feed mechanism is then released, the head is returned to its starting place, and the seam, straight and even, removed from the pins, and the cloth feeding

mechanism started. This process is repeated with each seam. The usual method is to roll the goods into a roll of about 20″ to 30″ diameter containing from 1,000 to 1,200 yards; by handling the cloth in rolls it is kept straight and free from wrinkles and in proper shape for brushing or cleaning. When the product of the mill is largely confined to one class of fabrics, it is sometimes found desirable to have an endless apron or an inclined scray, at the back of the sewing machine, connecting it with the brushing machine, and plait the goods down upon this apron, the operator at the sewing machine keeping three or four cuts of cloth ahead of the take up from the brusher. This makes the sewing and cleaning substantially one process and saves the time taken to stop the brushing machine, when sewing together the ends of each large roll of cloth; at the same time the objection may be raised, that it does not keep the fabric in as smooth and clean condition, as the rolling up method does. To sew the ends of the large rolls together, it is usual to employ a railway sewing machine of the portable pattern, giving a seam the same as that made by the previously described machine. As already stated the sewing is usually done on a machine of the railway or traveling head pattern, as this gives a better seam and a neater operation. More or less rotary or column sewing machines are in use, but no device for rolling or folding is used in connection with this style sewing machine, so that it has a serious disadvantage, in wrinkling or mussing the fabric.

Before we speak of the next machine, let us examine a piece of the goods and see what is required to put it in marketable condition. Laying the goods out on a table, we find there are more or less chits, dirt, and pieces of leaf, either lying on the surface or partially embedded in the yarn, small knots or nubs in the warp or filling project and sometimes slugs or heavy places in the filling are found. We also notice hanging ends or strings, caused by the renewing of the filling as the bobbin runs out. The general unevenness or wrinkled character of the face of the goods is quite noticeable. How many of the defects

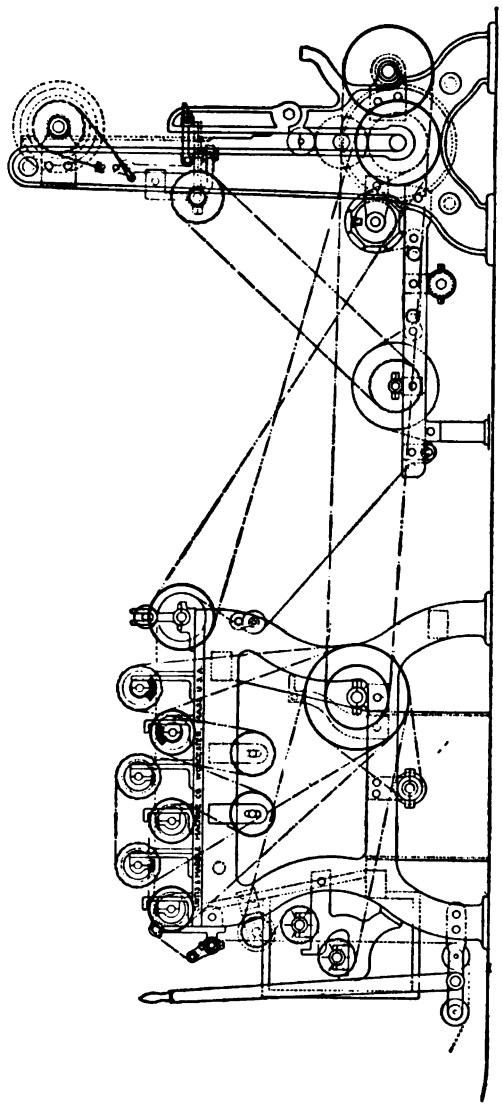
can we reasonably expect to remedy by mechanical processes? Surely the slugs must be removed by hand. The particles of leaf and chit that are tightly twisted into the yarn cannot be removed and we must not expect to remedy in the cloth room all the defects in cleaning the cotton or of carding or spinning the same. You cannot, by adding a few hundred dollars worth of machinery to the cloth room equipment, expect to use a lower grade of cotton and present to the market the same character of goods as could be made from a better grade of cotton.

Some of the mills on the medium and lower grade of goods have contented themselves with a simple brushing machine for cleaning the goods, while the more progressive mills are using larger and more complete machines—with shear blades, brushes and all the necessary cleaning appliances.

The cleaning machine proper consists of revolving appliances for treating both sides of the fabric. The different parts being arranged to suit the character of the goods or possibly the inclination of the purchaser.

The accompanying cut shows a cotton brushing machine arranged with one pair of emery rolls, and one pair of revolving beaters in front, and with two card rolls and one stiff bristle brush for each side of the goods on top, with suitable draft and tension rolls. It has an exhaust fan underneath to remove the dirt or lint, and is suitably encased to prevent flyings escaping into the room.

Referring to the cleaning appliances separately, we will describe them briefly. The emery rolls are first wound with twine, and then a heavy surfacing of coarse emery applied. These rolls loosen and knock off much of the heavier leaf, motes or chits, from the fabric. The beaters have steel blades which revolve against the fabric with a scraping action, similar to the hand work of the inspector. This action removes many of the small knots, nubs, etc., from the goods and at the same time loosens much of the other foreign matter, so that the card rolls and brushes can be used more effectually. The card rolls are perhaps the least understood, as they do not have a carding or



BRUSHING MACHINE WITH CALENDER ROLLING.

napping action, but on the contrary, as the card clothing on these rolls is made with a somewhat straighter tooth than usual, and the rolls run with the bend of the teeth pointing backward, the numerous wire points remove smaller chits, specks or motes, without disturbing or napping the face of the fabric. The brushes are filled with the best quality of Russian stiff bristles, and these are the only bristles which are effective for cleaning the goods; softer or cheaper bristles not having the stiffness or elasticity necessary.

We have described the usual pattern of brushing machine, which is used on heavier or coarser goods.

On lighter weight goods the emery rolls may be covered with finer emery or omitted altogether. Brushes may be substituted for some, or all of the card rolls, and on still finer goods, brushes alone would be used. Rolls covered with sand paper of varying grades are at times found quite effective, though the paper requires replacing often, and unless renewed as soon as the grit is worn off, is of little value. While this brushing machine will remove a very large portion of the foreign matter, there will remain many of the threads, and some of the knots and nubs. The loose ends and more or less of the undetached threads are caught by the emery rolls, card rolls and brushes, or scraped off by the beaters. To thoroughly remove the threads, shearing appliances must be used and the combined shearing and brushing machines will be considered later.

While the sewing and brushing processes are distinct and separate, it has been found quite desirable to so arrange these machines, one behind the other, that the rolls of cloth when taken from the back of the sewing machine can be readily passed to the front of the brushing machine. Trucks with concave beds are sometimes used. Tracks or rails raised a little more than one half the diameter of the roll of cloth from the floor and the length of the winding rolls apart, connect the two machines. On these tracks several rolls of cloth may rest, and the ends of cloth can be readily connected, with but little lifting or handling of the rolls.

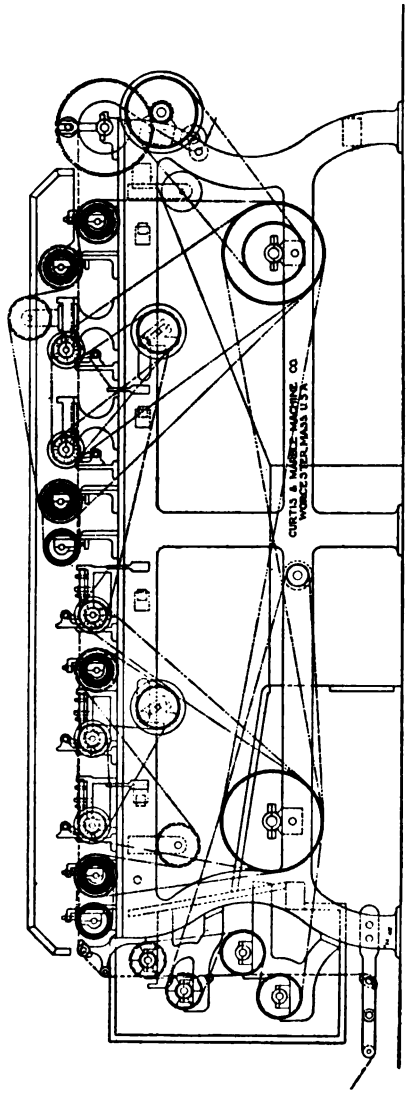
All brushing machines or combined shearing and brushing machines are regularly provided with either rolling up attachment or plaiting down device. For goods that are to be sold in the brown, or sent to the converters in a roll, an attachment known as the calender rolling machine or head is largely used. This is an upright frame in which there are two rolls; the cloth enters over proper spreading devices, passes down under the bottom roll, between the two rolls and around the top roll to a wooden roll above, on which it is rolled. These two iron rolls are usually heated by steam and the top roll driven by gearing at a slightly increased surface speed over the bottom roll,— this gives an ironing effect, which straightens out the fabric, smooths out the puckers and wrinkles and rolls the goods in a smooth, hard ball. When the rolls are to be used hot, a steam vapor cylinder is placed in front of the machine so that a slight dampening may be given to the goods before being acted upon by the iron rolls. The wooden roll on which the cloth is wound is held in contact with the top iron roll by racks, which are so arranged with gearing and friction device that any required amount of pressure can be applied, to make as compact and hard a roll as desired. The two iron rolls do not come directly in contact with each other, but are held a little apart by wedges between the bearings, which can be adjusted so that the rolls may not have the effect of crushing the texture of the goods. For goods sold in the brown, it is usual after they have been dampened, ironed out and rolled up, in this way, to allow them to remain on the rolls for a few hours or over night, since by so doing a much smoother effect is produced and a softer "feel" given to the fabric. In connection with this calender rolling machine, various additional attachments are often furnished. A revolving spreader roll is used when the fabric is light, or by its composition liable to wrinkle or crease. This spreader roll delivers the goods to the rolls free from these objections and without undue strain or stretching in width. As many of the goods are delivered in the form of large rolls to the converters, a measuring device is required to measure the goods accurately

as they are being rolled up. For this purpose a roll is used presumably one yard in circumference, to which is attached a dial indicating the number of revolutions, corresponding to the number of yards run. But as the goods vary in texture, elasticity, and amount of stretch when under tension, a measuring roll in its primitive form is not a very reliable device. To overcome variations in the fabric or conditions in running, the measuring roll has an adjustable pulley on the outer end of its shaft, and from this a belt runs to the recording portion, which is placed on the side of the machine in the most convenient position for reading the figures on the dial, at the end of each roll. The pulley on this recording device is of the same size as the adjustable pulley when at its mean diameter, and indicates the same number of revolutions, but should the actual yardage as tested by a yardstick or on a table, prove to be less or greater than the indicated revolutions, a slight variation in the size of the adjustable pulley will cause the dial to indicate the correct measurement. A variation of a slight percentage in stretch will be hardly noticeable in a single yard, but its repetition will make a decided difference in the total product for the month. Even a testing of the yardage by the usual method on the folding machine is not by any means positive, as the same or a counter variation may be shown, in the number of folds made. Better have the measurement tested on the floor or on a ten-yard table, and then carefully adjust the recording device to correspond.

An important point to be considered when running the calender rolling machine in connection with the brushing machine is the matter of tension or strain on the cloth. The calender rolling machine is driven direct from the main shaft of the brusher or shearer and the calender rolls become the draft rolls of the combination. That there may be no undue straining of the cloth between the two machines, it is desirable to provide some means for assisting the cloth in its movement through; this object is attained by providing a draft roll on the brusher or shearer with an adjustable pulley which is driven from the lower of the two rolls on the calender. This adjustable pulley allows

you to regulate the surface speed of the delivering roll, so that no strain is caused by the taking up of the cloth by the calender rolling machine. Should the tension on the cloth between the two machines be excessive, the cloth will be drawn down in width and the warp may be subjected to such a strain as to injure the texture of the fabric.

The combined shearing and brushing machine is the most complete cleaning appliance yet introduced into the cloth room. It is an elaboration of the machine already mentioned. Sets of shear blades are added for one or both sides of the goods and are arranged in connection with the other cleaning appliances in different combinations, varying with the quality of the fabric and the treatment it requires. While the face of most goods requires more cleaning than the back, sheetings and similar fabrics must be treated substantially the same on both sides. The combination shearing and brushing machine here shown is known by the makers as model No. 55, and has the following arrangement of parts. The front of the machine where the cloth enters is provided with emery rolls and beaters of the same pattern as described in connection with the brushing machine. On the top, first a card roll, then a brush, then two sets of shear blades, then a second brush and a third set of shear blades, all for the under side of the goods. For the upper side of the goods, we have a card roll, a brush, two sets of shear blades, and back of the top shear blades there are brushes set with softer bristles for both face and back of the goods; these two last running in a direction opposite to that of the goods, and being used to pick up and remove any lint or threads which have been loosened by the previous cleaning rolls. The brush for the upper side of the goods is provided with a pan or trough into which the loose dirt is thrown, while the brush below the cloth throws the particles into the hopper to the exhaust fan. It is quite necessary to adjust the contact of the cloth on the various parts so that each shall do its proper amount of work. The emery rolls can be brought to bear quite hard against the goods, and the beaters made to scrape somewhat severely, both



NO. 55. SHEARING AND BRUSHING MACHINE.

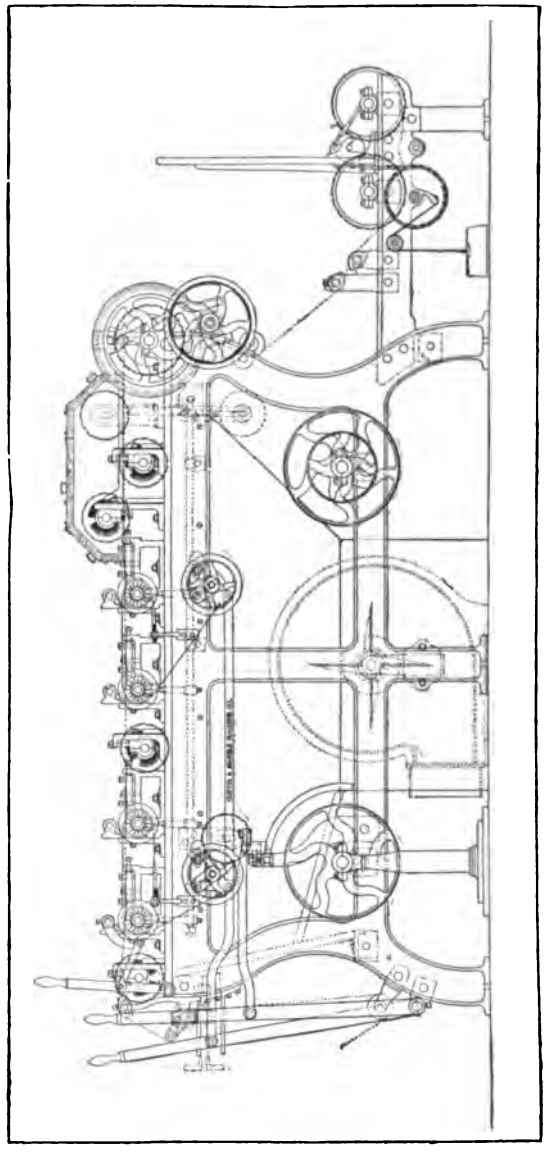
of them running against the travel of the goods. The card rolls preferably run so as to throw forward, or with the goods, as do the brushes in front of the shear blades. Of the shear blades and their use much can be said. They consist of a revolver, or revolving cutter running in contact with a stationary blade. The adjustment of these two cutting parts, though comparatively easy, requires some mechanical ability, but it must receive careful attention. In examining the cutting parts in different mills, it is no unusual thing to find the revolver and ledger blade, either not in contact with each other, or so dull that they simply catch a projecting thread and draw it between them, should the thread be of firm enough composition, the fabric is also drawn into the cutting parts and cut or torn. Whereas, if the parts were in proper condition, the thread would have been severed close to the fabric. It may be that through inattention the cutting portions have not been properly oiled and allowed to run dry, in consequence, have become chafed or rough, and oftentimes the temper is drawn so that the high grade steel which forms the cutting section is worthless, and for practical use, of no more value than a tin jackknife blade.

This is not the place to go into the details of grinding and adjusting these cutting parts, suffice it to say that with proper care and adjustment they are the most valuable additions to the machine for the removal of threads, fuzz or nap.

The combined shearing and brushing machine described is one of the most complete arrangements manufactured. It may be that the mill is called upon to make goods of entirely different organizations. The overseer of the cloth room has but to remove, or change the belts driving the different appliances, to stop emery rolls and card rolls for lighter weight fabrics, or he can so modify the combination, as to adapt the machine to nearly any class of fabrics.

Several years ago the following plan of taking care of the cutting parts was adopted by one of our progressive agents. He first procured an extra set of bottom and top shear blades, and had his four shearing machines put in good condition;

selecting a clear headed young mechanic, he sent him to the works of the makers of the machines and arranged to have him receive suitable instruction in grinding the cutting parts together and in setting and adjusting them. On the young man's return, it was arranged to have the machines examined every Wednesday during the noon hour, and every Saturday forenoon, while the room was being cleaned up. If any of the shear blades were out of condition, they were adjusted, or, if necessary, were replaced by an extra set. Any other little repairs such as the adjustment of vibrate blocks and levers to take up wear, the cleaning and tightening of belts or similar work, were done at the same time. During the week, at such time as was most convenient, the spare set of shear blades was overhauled, ground together and adjusted ready to replace another set, or if they were worn out or required extensive repairs, they were sent to the maker. We can speak from experience, when we say that this set of machinery is returning good interest on the money invested. What is being done in this mill can be done in others, and in many cases would greatly improve the results now being obtained, and I venture to say that one third of the brushing and shearing machines in use are not doing more than one half the effective work they should do. Oftentimes the brushes are worn and uneven, the bristles being nothing but stubbs; the beaters worn smooth on the edges, so as to be without any scraping value; the emery rolls worn off in places, or so filled with dirt as to be without value for cleaning. Perhaps the draft roll has been worn smooth, and some one unacquainted with the results has recovered it. It may be he has tacked the cloth on, and as is sometimes the case, driven tacks along the centre of the roll so that at each revolution of the roll a tack head is brought into contact with the cloth. If there is an iron roll on top of the draft roll and the tack head projects a little, the chances are that a little break in the thread will occur and be brought to light when the goods are finished. Probably more yardage has been damaged by carelessness in this way, than by any other fault in the cloth room.



NO. 431. SHEARING AND BRUSHING MACHINE.

If the product of the mill is other than sheetings or drills, a pattern of shearing machine differing from the style above mentioned, may be preferable. Should it be necessary to finish but one side of the goods, a machine similar to that known by the makers as model No. 431 may be substituted. This machine is arranged with a brush, two sets of shear blades, a second brush and two more sets of shear blades, all for the face of the goods, and following these is a brush for both face and back of the goods, for removing any loose particles of lint or dirt. The machine shown has the horizontal rolling brackets with weighted slide, controlled by cam movement so arranged as to exert the greatest pressure, on the wooden roll, when the cloth roll is first started. To this arrangement may be added a combination of cleaning parts, in front, composed of emery rolls, beaters or brushes for one or both sides of the goods. In this connection, it may be well to state that the term, *combined shearing and brushing machine*, is about as comprehensive as the term, *a suit of clothes*. These machines are built in more than forty combinations of cleaning parts, on the top of the machine, eight or more combinations known as front attachments, and at the rear various rolling, calender rolling or folding attachments; all of these arrangements may be called for in widths varying from 30 inches to 72 inches of working surface, or, in the matter of the brushing machine, for goods from 30 inches to 144 inches wide. Should you desire to order a machine, don't be disappointed if the maker has not in stock, the particular arrangement in the particular width, best suited to your conditions.

From the cleaning machine, the goods will be shipped to market either in rolls or in folds. Those that require folding are taken to the folder or yarding machine and put into suitable form. In this connection, a matter of considerable importance to the mill may be spoken of. We usually refer to this machine as a yarding machine, meaning that it puts the goods in folds, which, we in all honesty, say are yards. Strictly speaking, this term yarding is a questionable statement, and we will give two reasons for our reference, — when unfolding the cloth and com-

paring the fold marks, laying the fabric so that top and bottom folds can be compared, we find the top folds do not correspond with the bottom folds, the tendency being to an elongation in the upper folds, this is caused usually by the rounding up of the cloth in the centre between the jaws, as it is laid fold on fold by the machine. Another defect may be noticed. While the machine may be set to fold an exact yard, varying tension on the goods may give a different measure, and what may be correct yardage on one class of goods may show a difference on another class. While errors of but a trifling nature have come to our notice, yet as most cuts are comparatively short, the accumulative error is not easily shown on that cut, but the aggregate yardage of the mills as shown by the folds, may be far from correct.

Take the matter of rolls that contain 1,000 or 1,200 yards, the accumulative error is more readily noticed.

The use of the automatic drop centre device on the folding machine, has overcome much of the irregular folding in each piece, while the machines of more recent build have been nearly perfect from a mechanical standpoint. Of the two different arrangements of folders known as the high front frame and the low back frame machines, each has its purpose. The high front machine, which feeds the cloth into the folder over the head of the operator, is used largely for finished goods; while the pattern which delivers the goods from the back toward the operator is used for goods in the brown, or on the general run of soft goods. The delivering of the goods over the head of the operator has one serious sanitary objection. Any dust or dirt is liable to drop on the head or shoulders of the operator and the covering of the head by a cap is quite necessary. A recent improvement in one make of machine may be noticed; viz., the swivel rod which tips the blades, through which the cloth passes, has been changed. The older machines had this rod swinging from the bottom and as it swayed back and forth with each movement of the blade, it was rightly called the *eye slasher*. This rod is now hung from above and swinging below the line

of the table avoids any liability to strike, or interfere with the operator.

When and how to finally inspect the goods is the question that appears to be the most difficult to answer. The time and expense that must be charged to this portion of the cloth room always looks large. " It seems like making the cloth room pay the expense of correcting other people's faults," said an old cloth room overseer a few weeks ago, and that is the idea carried by others similarly situated. It seems inevitable however, that the cloth room, like charity, must cover a multitude of sins. Many faults in the fabric, caused by imperfect working of various machines and operators throughout the mill have been brought to light in the cloth room, and must be corrected as far as possible by the operators in that department. Remove the cause of the faults, as much as you can, before the fabric reaches the cloth room, but you must still provide means to remove some faults after the cloth has been cleaned and prepared for this inspection.

CLOTH INSPECTING MACHINE.
With Reverse Motion and Rolling Head.

Of all the different machines which have been arranged for this work, the most popular is the plain inspector, with inclined table, cloth cradle in front below the table, draft roll with forward and reverse motion at the upper part of the frame, and

either rolling or folding attachment at the back. The cloth is placed in the cradle and brought up to the table — a slight pressure on the long treadle in front starts the draft roll, and the cloth having been passed into the bite or nip of the rolls is drawn up the inclined table away from the operator, as long as the operator keeps her foot on the treadle. The dark background of the table assists in disclosing imperfect work and whenever the foot is removed from the treadle the fabric stops, allowing the imperfect spot to be picked out or up, combed over or brushed. The work of inspecting the cloth is pleasanter for the eye and less tiresome if it passes upward, than if drawn down toward the operator. It may be that a defect shows for quite a distance, a broken selvage is found for a yard or two — in such cases the foot is removed from the front treadle, and placed on the side treadle, and the cloth is drawn backward from the roll and slides down the table, so that the extent of the injury is noticed and proper allowance can be made. The machine is light running, all parts are easy of access, and the slant and height of the table such as will suit the average operator. This machine is used in different mills for an examination of the cloth in the weave room before it is cleaned, also for the final inspection after it has passed through the brusher or shearing machine.

The question of the direction of the travel of the cloth on the inspecting machine has not been settled to the satisfaction of some and a few mills are using machines arranged to run the cloth the reverse way. The cloth is placed in a cradle on top and drawn forward over the table, and then to the rolling head at the back. While the method has its advocates it is open to some objections.

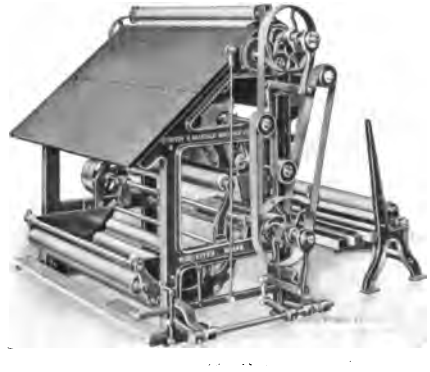
A method used in some mills is to wait until after the goods are folded and then lay them out on a table, and then by turning back each fold, examine and correct in that condition. The opposite side of the folded goods is then handled over and similarly examined. This method has serious objections, the principal one being, the fact of disturbing the folds,

and should any imperfect places be corrected, the inconvenience of handling the individual fold of cloth. It is considered less perfect an inspection than the inclined table method, and at its best is rather an examination of the general appearance of the goods, than a close inspection for the correction of faults.

We have endeavored to give in a general way the requisite treatment of sheetings and drills, with the modifications required for some of the finer fabrics.

Muslins and fine lawns which will be injured by any severe action of the brushes or other revolving parts require some other modifications. Being better prepared in the card room and the spinning room the yarn goes to the loom almost perfect. The weave room examination is more for the purpose of disclosing any loom errors, particularly, thick and thin places in the cloth. For this class of fabrics the shearing machine has usually two sets of shear blades for the under or face side of the cloth, and one set of shear blades for the upper or back of the cloth, with the necessary brushes for each side of the cloth before and after the shear blades. The brushes are as stiff as can be used without distorting the fabric and the entire machine arranged to handle these delicate fabrics.

As this class of goods is subjected to a closer examination on the counter, we must give them a closer inspection, and what



C. & M. CLOTH INSPECTING AND TRIMMING MACHINE.
With Three Brushes, Reverse Motion and Rolling Head.

has been called the cloth inspecting and trimming machine is generally used. Its general construction is similar to the plain cloth inspector, previously noted, but it has in addition three revolving brushes, one of which cleans the face and the other the back of the cloth before it reaches the table. The third brush acts upon the face of the cloth after the inspection, removing loose threads or lint which may cling to the fabric. The starting and stopping of the cloth is by means of foot treadles, with an arrangement similar to that on the plain machine, but the brushes are so driven that they revolve only when the cloth is moving forward, stopping when the cloth does, and remaining stationary when the reverse motion is used. These brushes are of special construction and stiffness and are only applied to this particular machine. The cloth cradle in front and the rolling up or plaiting down device at the rear complete the machine.

We have not touched upon the baling press, or the shipping arrangements as they are usually well arranged and not particular to any one class of fabrics.

Were it admissable to extend this paper, we would like to consider the lighting of the room, the arrangement of the dirt and dust removing devices — the placing of the machines in the proper sequence, the special modifications for broad goods, as well as those for heavy ducks. One point alone would we like to refer to and a point that should receive special consideration by those fitting up new cloth rooms or remodeling old ones. Why not equip each machine with an independent motor with self contained drive, and avoid the belts with their dirt and lint carrying properties so prominent. Make each machine or group a unit, to be started and stopped as wanted, and use no power except when obtaining results. It will be the ideal cloth room drive.

In conclusion, let me say that within a few weeks, propositions were on my desk for consideration, which call for machinery to finish these fabrics. — Cotton duck from 1 inch to 144 inches wide, and from 8 ounces to 32 ounces, weight based on a width

of 22 inches, fine lawns and silk stripes, gauze weighing 1½ ounces per square yard, print cloths, 120-inch sheetings, zephyr ginghams, and colored dress goods, and in attempting to cover in this paper a cloth room equipment that with suitable modifications would be adapted to any of those mills, we understood full well the task and beg your indulgence for the way we have performed it.

Data received since the paper was written, gives further endorsements to the unit or small group plan or drive as applied to cloth room, the matter of cleanliness and convenience of operation being quite important factors in this department.

Mr. EDWIN H. MARBLE. It was my purpose in the first place to take this paper page by page, but in talking with two or three of the members I have been requested to drop the paper as far as possible; and if anyone present would like to ask any questions in regard to the cloth room equipment pertaining to their particular mill, I would much rather do that — answer your queries, than to follow the paper, which you can read at your leisure better than here.

The PRESIDENT. Gentlemen, do you desire to ask Mr. MARBLE any questions?

Mr. DANIEL MOORE BATES. Mr. President, there is one matter I would like to touch upon in Mr. MARBLE'S paper, which I have listened to with interest. That is with reference to the matter of measurements.

Now we as bleachers very often come up against this proposition, that we are not getting the gain we used to, and we do find, as Mr. MARBLE has stated, that occasionally a hundred folds will not represent 100 yards. For instance, the machines will

measure 35½ to 35¾ instead of 36 inches full, and this one-half or one-quarter of an inch when it comes to a lot of 100,000 yards means quite a yardage.

The same way with goods coming on rolls. We ourselves find the same careful attention necessary in seeing that our folds do represent yards.

Now, we are often put in the unpleasant position of making complaints about the yardage of gray goods, just for the reasons given, and I am glad to note that the fact is recognized and has attention in the cloth rooms from which the gray goods come, as I understand that Mr. MARBLE speaks from the manufacturing and not the bleaching end of the business. It is a satisfaction that, as we run often into disputes about the matter of yardage, the manufacturers realize that it requires careful attention, being one in which mistakes are likely to occasionally occur.

Mr. EDWIN H. MARBLE. A short time ago I received a message from the far South, asking me to meet parties in New York at once to go over a matter of difference in yardage between one of the larger southern mills and the converter.

They had given the test in the first place to one of those professional measurers or adjusters in New York City, and he had decided in favor of the converter by quite a margin.

Taking two pieces of goods from a bale we compared the indicated measurement with the floor measurement, laying the goods out flat on the loft floor so that we could get a flat measurement with a steel tape. After comparing the actual with the indicated measurement, the adjustment was made on the machine to correct the difference, and after five or six pieces had been tested the machine recorded the actual measurement on piece after piece as tried.

Another case was brought to my notice where a difference was found, two classes of goods had been run on the same folding or yarding machine; one was quite light, and then a change was made to goods of nearly twice the weight — heavy twills,

running them with the same tension on the machine, — in one the yardage varied in the pieces, I think it was between 1½ and 2 per cent. over, while the other was as much under the correct measurement. They had been measured on the same machine, but one being so much heavier than the other the lighter goods were pulled out of shape; whereas the heavier ones would stand the strain and show a better measurement.

The Bigelow Carpet Company will not measure a piece of Brussels carpet and a piece of Wilton on the same machine; they have two machines, one adjusted to Wiltons and one to Brussels, because they find the difference between a rough back and a smooth back in the course of a week makes a very perceptible difference in their total yardage.

Mr. DANIEL MOORE BATES. I would say further in connection with this matter of measurement that sometimes when we check over a bale of goods we find the yardage we get is always a little in excess on each piece of what is marked the piece yardage, and I assume in such cases that the mill has noticed a variation, and has allowed for it.

I also would add that the question that came up as to checking measurement did not get so far as a sworn measurer; we usually get a five-yard table, and pull the goods over that. But it is rather hard to settle on a standard way of measuring agreeable to all the parties concerned. We usually get a five-yard table and use that.

The PRESIDENT. We are appreciative of Mr. BATES' remarks. Is there anything further in connection with this matter? if not, we will proceed to the next paper by Mr. WILLIAM HAYES.

BATTEN AND HAYES ADDITIONAL TOP STRIPPER ON REVOLVING FLAT CARD.

WILLLIAM HAYES, Auburn, Maine.

A year ago last fall I addressed this Association, also a year ago, regarding the Batten and Hayes additional top stripper on the revolving flat card. After various tests at different mills, I feel justified in calling your attention to the merits of the Batten and Hayes Additional Top Stripper the third time. The revolving flat card as it is running to-day, although a beautiful machine, was overrated; it did not take out as much short fibre or lay the staple as nearly parallel as was expected and many mills reduced the production of the card in order to get better work. All the cards are built much alike and all have the same defect, namely the tops travel on the cylinder too long without being cleaned. The tops are about filled at the crown of the cylinder, and during the last half of the carding surface, the carding efficiency decreases and the tops, failing to hold the dirt, and short fibre, are carried forward into the work.

There are many mill men who would like to have a percentage more of cards as their goods demand lighter carding and have no room to put them, therefore run their cards evenings and some even run their cards noon times.

The Batten-Hayes device is simply an additional top stripper on the crown of cylinder; the tops strike the back of cylinder as usual and cards as usual until they reach the crown of cylinder at which point the tops leave the cylinder in the regular traverse and pass up over an arch or bridge, and are stripped

as they proceed and then return to the cylinder clean and are stripped the second time at the end of the last half of the carding surface.

Our additional stripper on top of cylinder takes out larger leaf and removes a much lower grade of strippings than the

FIGURE 1.

BATTEN-HAYES ADDITIONAL TOP STRIPPER ON REVOLVING FLAT CARD.

regular card does with twice the carding surface. The first half cards the cotton, the last half, the tops traverse on cylinder more than cards it and to some extent combs the cotton and makes a special preparation for combed work, the staple being cleaner and more of the fibres laid in parallel.

This extra stripper enables us to run our tops one third slower and at the same time, the tops and cylinders are kept cleaner.

The first card which was changed over at the Barker Mill, Auburn, Maine, was put up to two hundred (200) pounds in ten hours against its regular output of one hundred and fifty (150) pounds in ten hours and many experts called it a marked improvement and the yarn was cleaner, smoother and stronger.

The first strippings are carried to the side of the card by an apron and from there into a can: front strippings are white and clean and can go into regular work up to 30 or 40 yarn we think.

One noted hosiery mill agent allows me to say that he, by his own test "Got cleaner work and more of it."

The Barker Mill has changed over all its recently installed 45-inch cards. Many experts claim that our yarns and cloth match the medium grades of combed work. We have recently made a test on combers with fifty pounds of Peeler cotton which was sent to our mill. We carded 85 pounds in ten hours against their seventy pounds in ten hours and the cotton went through their combs without any change in adjustment; the comber laps being of the same weight, and the cotton from Batten and Hayes device made ten per cent. comber waste against their fifteen per cent. comber waste and the carder at this mill acknowledged that the new device led their carding twenty-five per cent. Mr. BATTEN is my carder and so far as we know we believe it is simply a question whether the mill men want an improvement of from fifteen to thirty per cent. in their carding.

That we believe this device will lead to a larger card with still more additional top strippers and superceded to some extent the cost of combed work.

In using stock from cards equipped with this additional top stripper, intermediates and flying frames run with less stoppage. One fly frame on a test ran five hours without breaking any ends and the drawing and roving is much cleaner and more even. Similar results occur in spinning, where the work runs much better and the yarn is cleaner, more even, and tested stronger.

Both mule spinners and warp spinners noted marked difference in the work, and there was about half the usual amount of

flyings on the mule carriages and on the spinning frames guide wires, boards and under clearers were more free. Similar advantages occur in the spooling, warping, and weaving, both in the run of the work and the results as are indicated by the samples of cloth and sliver accompanying this paper for the inspection of the members.

The PRESIDENT. The opportunity now presents itself for a very interesting and instructive discussion upon perhaps, the most important point — the backbone of the whole process of cotton manufacturing. Does any gentleman desire to ask Mr. HAYES any questions?

Mr. WILLIAM HAYES. Here is a comber (referring to samples which were handed to the members for examination) directly from the mills, carded 70 pounds, takes out 15 per cent. and here is another 85 pounds, 20 per cent. more cotton, and saves 5 per cent.

Mr. JOHN W. NASMITH. I should like to ask, Mr. President, if Mr. HAYES can tell us what is the increase in the per cent of waste. That stripping the flats twice must necessarily increase the amount of waste. That is compensated somewhat by decrease in the speed of the flats, and by increase in the production; but at the same time there must still be an increase in flat waste by stripping twice, and it would be interesting to know what the increase in the percentage of flat waste is.

Mr. WILLIAM HAYES. The waste is just about the same. That is, the middle strip took out larger leaf and almost like the dirt under the card, brown stripping. That you do not see in front and the two together, they average just about the same; the first and second strippings are just about the same. Although the difference is just about here: we got out the larger leaf that gets ground up in the regular card.

Mr. JOHN W. NASMITH. By grinding it up you get rid of it?

Mr. WILLIAM HAYES. The waste is just about the same. The front and middle stripping waste just about the same as the ordinary stripping, and the advantage is we clean the tops when they get filled up; and we simply just push the card to the best possible speed, which we think has never been done before.

Mr. J. R. MONTGOMERY. There is one thing here in the paper which attracted my attention. It says that he "makes a special preparation for combed work, the staple being cleaner and more of the fibres laid in parallel."

I would like you to explain in what way this lays the fibres in parallel.

Mr. WILLIAM HAYES. Take the carded sliver and there is a difference in the looks; there is more fineness in it. We clean the cop where dirty, and the first half cards it, and the last half cleans it more and makes fibre more nearly paralled.

Mr. J. R. MONTGOMERY. I want to know if there is a mechanical device for holding the staple so as to comb it.

Mr. WILLIAM HAYES. The extra carding does it.

Mr. J. R. MONTGOMERY. You do not usually expect a carder to lay fibres parallel.

Mr. WILLIAM HAYES. It gives a better action upon the cotton, and it combs it out cleaner and more parallel. That is the absolute fact.

The PRESIDENT. The next paper on The Warp-Tying Machine is by ex-president E. W. THOMAS of this Association, and who is detained by duties connected with a change of position to one of large responsibilities and his paper will be read by the Secretary.

THE BARBER WARP TYING MACHINE.

E. W. Thomas, Columbia, S. C.

Probably no one department in our weaving mill presents from the nature of its operation, more nerve destroying action affecting the operative than we find in the drawing-in of warps. The employee on this class of work has but very little opportunity for bodily exercise and it is the only process in the mill requiring persistent attention to the work of the hands and the watchfulness of the eye. And of late years, particularly since the introduction of the backstop motion, and the increase in the numbers of harnesses used, there has been and still exists in nearly, if not all mills, throughout the country a scarcity of skilled help for this particular department. As a partial remedy, the system of twisting-in has to some extent been adopted, chiefly from the fact, that male help could be obtained in limited numbers for this purpose. This solution of the problem, however, has not come into general use in this country for various reasons, which are unnecessary to relate in this paper.

Those manufacturers who are located in the North are to some extent aware of the fact, that efforts have been made to devise a machine for drawing-in, not so much to cheapen the cost, as to relieve the mills of the uncertainty at all times of being able to obtain females in sufficient numbers, to draw in the warps in the usual way. And credit should be given to those men who have succeeded in inventing and building

machines that will do this work. To make a machine, however, that will draw in through all kinds of harnesses, steel, wire or twine, and at same time draw through the reed and backstop motion wires, seems beyond the resource of our inventive friends. Something has, however, been accomplished in this line in a limited way, and I am told successfully, in so far as regular twine harness work is concerned. And I am told that some of the mills of New England have such machines in successful operation. Whether the cost of the operation is reduced or not, any such machine which will relieve this severe and fatiguing class of handwork in our mills, should be welcome. It would seem, however, that any machine now in use from the necessity of the case is limited in its service, if it cannot be used universally in a mill having a variety of kinds of harnesses, and backstop motions.

Within a few months, a machine has been devised that overcomes many of the objections of the drawing-in machine of today, and the following are the claims made for it: First, the adaptability for tying knots in the ordinary range of yarns; second, no special if any changes are needed to change the machine operating on warps containing various numbers of threads per inch; third, the fact that it makes no difference as to the number or kind of harnesses used or whether backstop motions are used; fourth, that it displaces to a great extent the ordinary hand process of drawing in.

The first of these machines built to be operated in a cotton mill was put in use August 3, 1904, and has continued in use until the present time. So successful were the results obtained that a second machine was placed in same mill about October 1 of the same year.

The broad principle of the machine is to tie the ends of the last of an old warp to the corresponding ends of a new warp, on the same principle in general that "twisting-in" is now done, but in a very much more satisfactory manner, in that the ends are tied instead of being twisted. The most remarkable features of the machine are its rapidity of action, its correctness and the

slight attention needed to operate, and last of all, that no special preparation of either the ends of the old warp or those of the new one is required.

The threads are automatically tied and the ends cut off by means of the same principle that is used in the spooler knotter, which nearly all of you have in use in your spooling rooms.

In this machine the knotter is speeded to tie about 250 knots per minute, so that in a warp having 2,000 ends, only eight minutes are consumed in tying the old and new warps together. In the mill above mentioned, where the two machines are being operated, warps are changed in less than two minutes. In other words, from the time the last knot is tied on one warp until the machine is ready to start in on another, the time occupied is not over two minutes, and oftentimes less. Within a few weeks one of our ex-presidents of this Association timed the working of one of the machines which was tying in warps with 2,500 ends of No. 28½ warp yarn on 42 inches spread in reed and five full warps were tied in complete in less than an hour. When warps are removed from machine they are ready for loom. As stated before, these two machines have been in operation for some months, and have supplanted in the amount of work they perform, the former requirement of from twenty-four to twenty-eight girls employed on hand drawing-in.

The warps in this mill have twine harnesses and backstop motions, and are used on Draper Looms.

This machine practically overcomes the objection sometimes made of the excessive cost of drawing-in, when using back-stop motions, and it certainly is a great cost saver to those who are drawing-in on a large number of harnesses.

The standard machine as made will tie-in warps up to and not exceeding 46 inches in reed and is geared up to work from and above 30 threads per inch. No more waste is made, if as much, as in ordinary processes. These machines have been seen by a large number of manufacturers and pronounced a most wonderful machine, and one that will strengthen the mill in a place where difficulty is experienced in obtaining sufficient

help. In as few words as possible I will try to follow the complete operation of the machine.

The first step is the taking out of the loom the last end of the warp after all the cloth possible has been woven. Previous to taking the harnesses from the loom, a slasher comb is put in the warp just back of them, or, in case back stop motions are used, in back of them, and the comb is then drawn towards the whip roll. Between the whip roll and the slasher comb are placed two wooden clamps, one above and one below the threads. These clamps are lined with felt, and hold the threads by tongue and groove action as may be seen in figure 8, keeping the warp ends fairly parallel.

The next operation is to cut the cloth front of reed, leaving about two inches in length, simply to maintain the ends of the old warp and prevent their slipping through the reed and harnesses After this, this portion of the warp extending through the reed, harnesses, and back-stop motion, if used, is all removed and placed on truck preparatory to removal to the drawing-in room.

The next process is to remove this piece of warp from the truck for the purpose of cleaning harnesses and reed from the lint that has collected on them. After cleaning the harnesses they are hung upon racks as shown in figure 8, and then are ready for use.

The floor space represented in figure 1 is about 20 x 30 feet, and the custom is generally to erect on two sides (if the location of machine is in corner of mill or room) a partition at any convenient height, say, about 8 feet. The machine has as its accessories two beam trucks, one loader, and an overhead carrying frame for conveying the old piece of warp from the loader to the machine proper. The beam trucks are arranged to travel in a path as shown by the curved lines on the floor. These accessories are not strictly necessary to the perfect working of the machine, but are furnished with the machine by the builders in order to be able to change the warps in an easy manner and to economize time. The loader is used to fix the old warp in position preparatory to placing upon the knot-tying

machine, and is conveyed to that machine by means of the overhead track represented in figures 2 and 3, which is attached to the wall or partition, as the case may be, and is located overhead and directly in rear of the loader and the machine. The new or full warp from the slasher is brought in the room and placed in either one of the beam trucks and swung around so that its sheet of threads may be brought into the machine and securely fastened preparatory to placing the old warp in the machine. Then the sheet of the old warp is placed over and directly above the sheet of the new warp. These may be clearly noticed in figure 5.

The machine is now ready to operate and is started in motion by throwing a switch, and the threads of the two warps are tied together and the ends, after tying a knot, are cut off. During the process of the traveling head traversing between the two sheets of threads and the tying of them together, the warp previously tied in, which, when removed, was in the other beam truck, is being handled by the operator in drawing the harnesses and reed and back stop motions, if any, along over the knots that have been tied. At this time should there be any broken threads discovered, these are attended to, after which the beam is removed from the truck to the regular loom beam truck, and is then removed to the weave room.

One employee can without assistance from others make this change of taking out and replacing a warp, and during the time the machine is tying in a warp, ample opportunity is given to prepare the warp to be tied in.

The following description of the machine it is hoped may be so explicit as to make the general working of it clear.

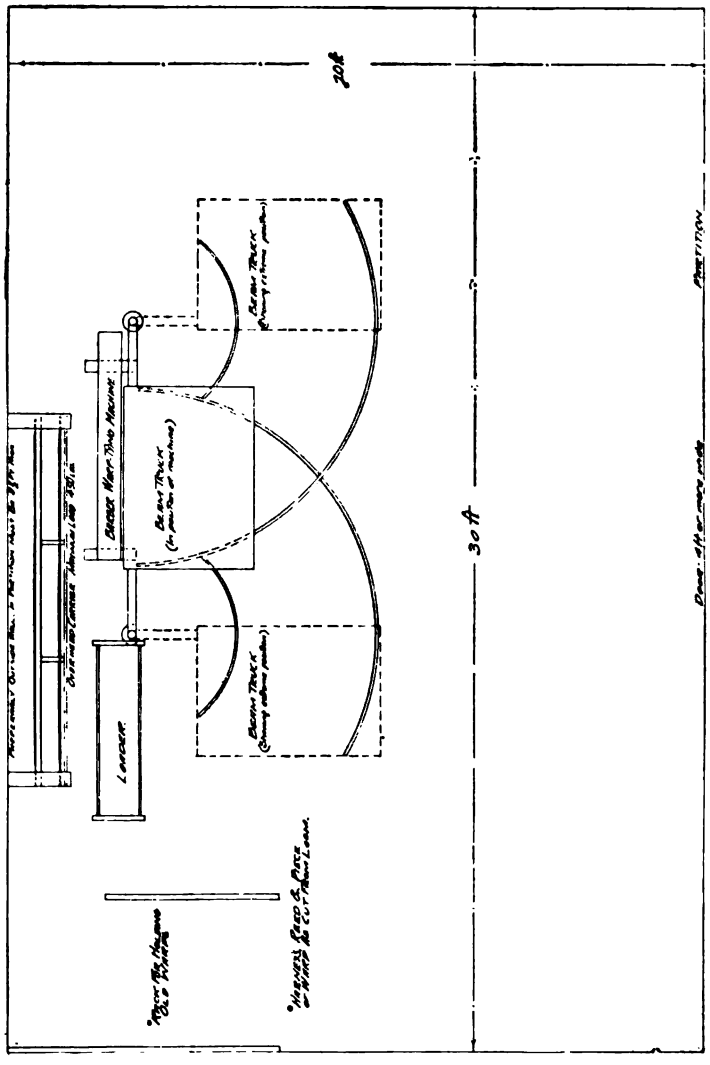


FIGURE 1. GENERAL FLOOR PLAN.

Figure 1 is a floor plan of the machine and accessories and represents ample room for convenient and economical operation of machine and handling of warps.

Figures 2 and 3 are general views of machine and accessories.

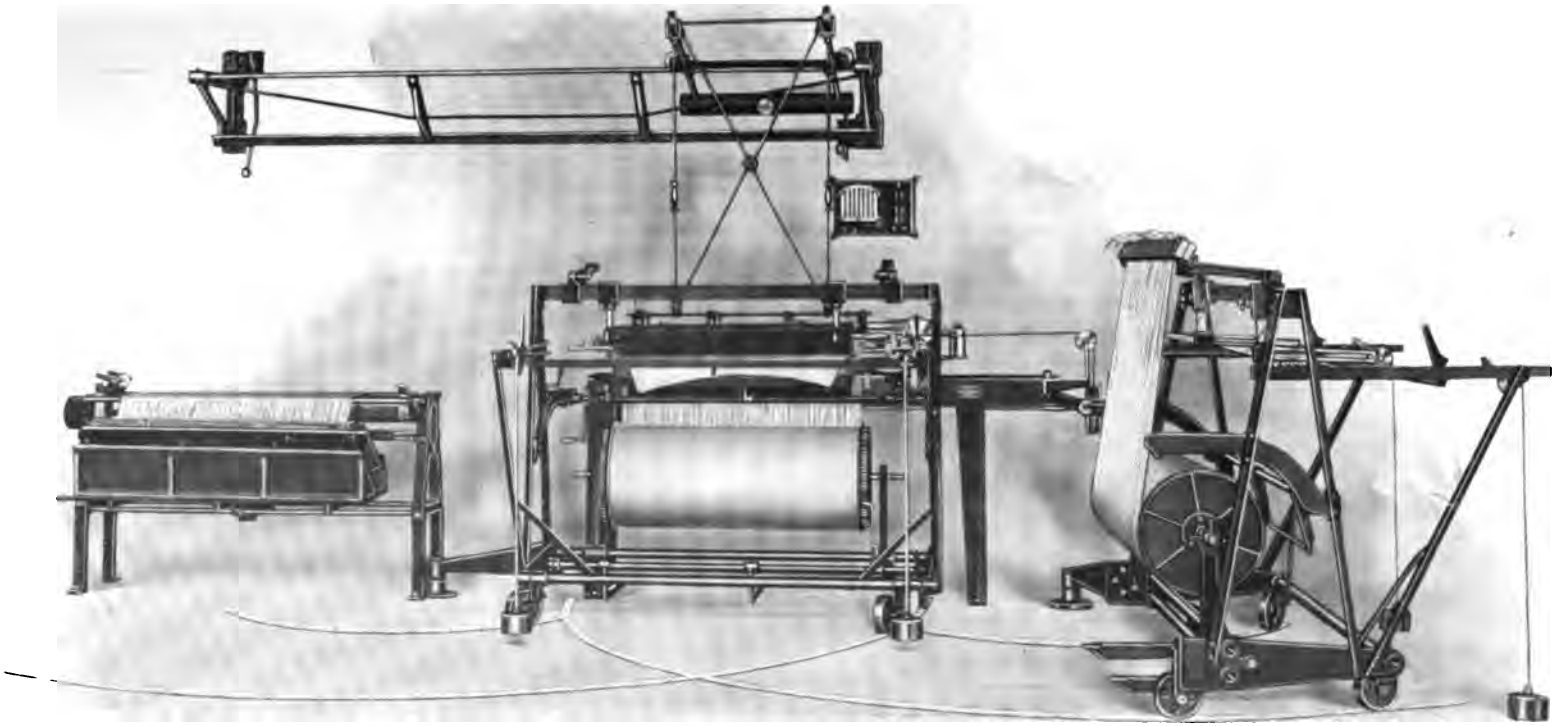


FIGURE 2.—ELEVATION OF LOADER, MACHINE, AND WARP TIER.

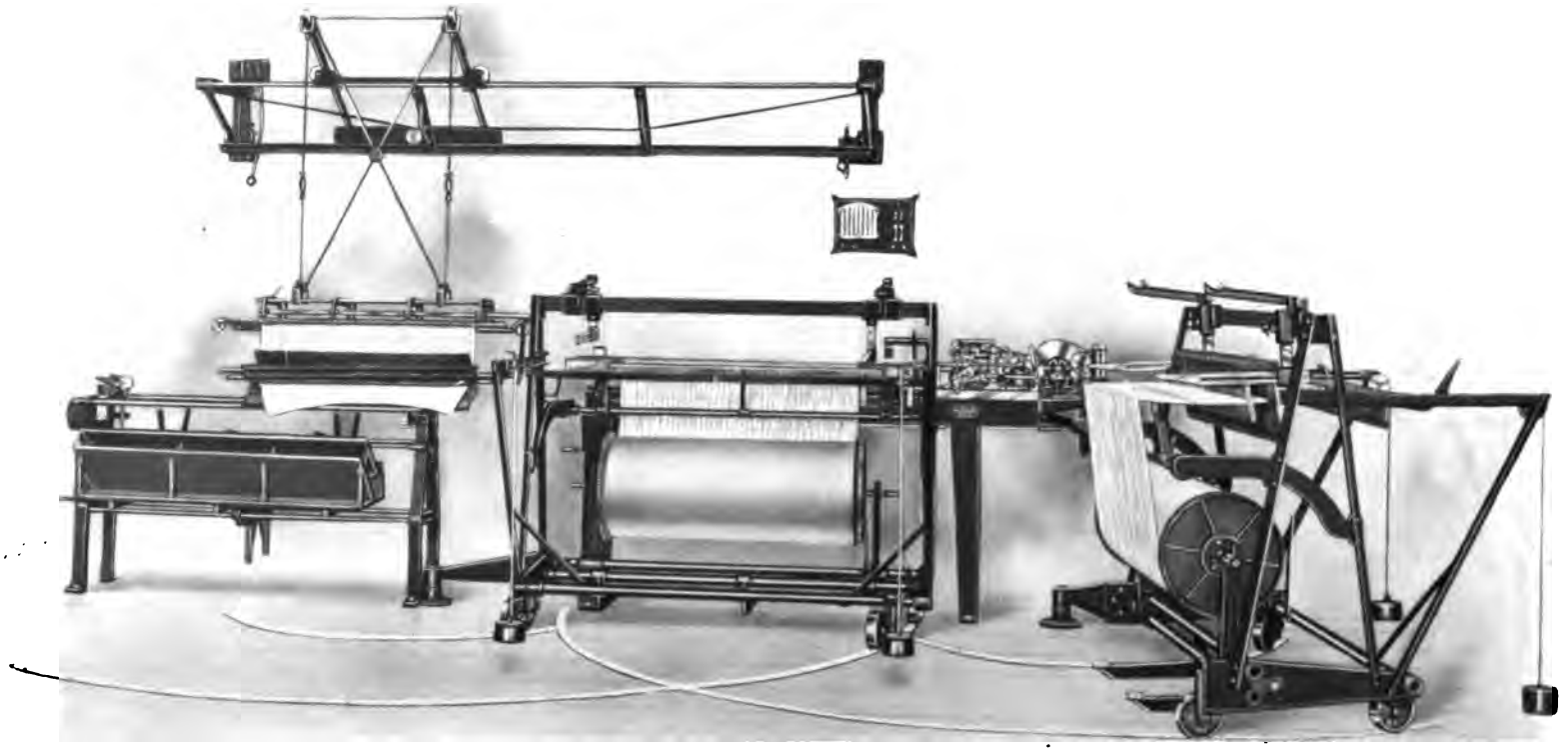


FIGURE 3.— ELEVATION OF REAR OF MACHINE AND LOADER.

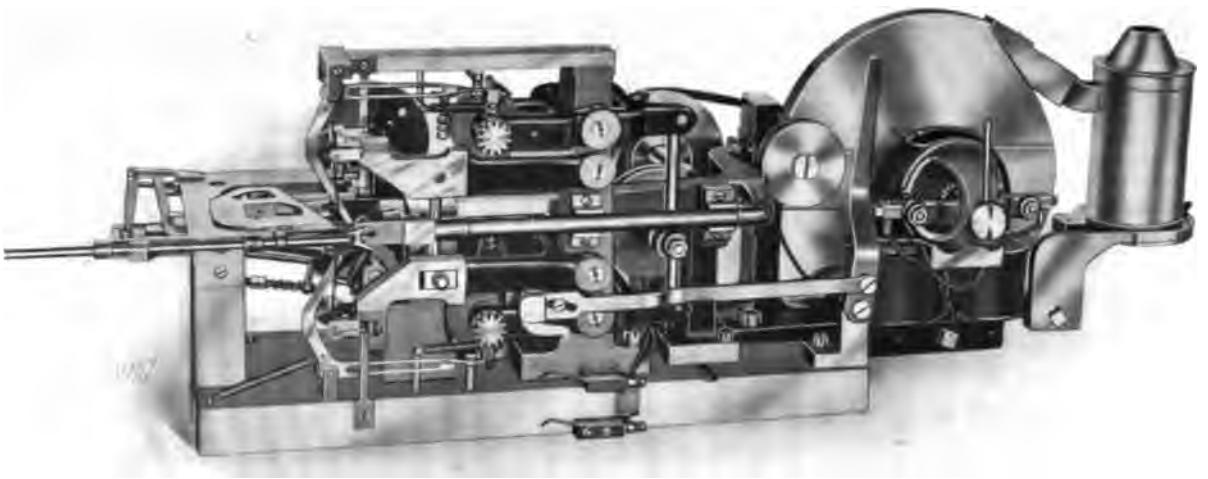


FIGURE 4. ELEVATION OF KNOT TYING MECHANISM.

Figure 4 shows the knotter carriage removed from the bed of the machine. The direct current motor which furnishes power for driving the mechanism is seen at the right. Upon its shaft is mounted a suction fan which carries the short ends trimmed off by the knotter and deposits them in the receptacle located at the extreme right.

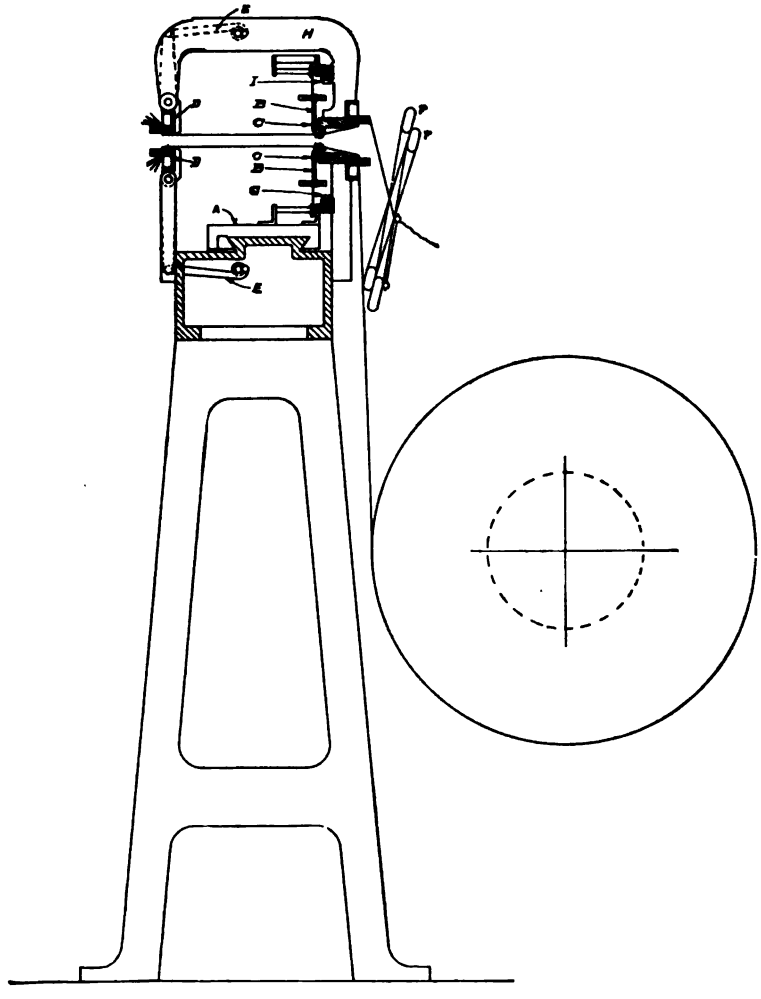


FIGURE 5. CROSS SECTION OF MACHINE.

Figure 5, is a vertical, central, cross-section, showing the relative positions of the machine, warp, and the harnesses; also indicating the location of the selectors and feed levers. The old warp is shown clamped in the warp carriage, the new warp in its clamps on the bed of the machine. The warp beam is supported in the beam truck. In this figure, *A* refers to the knotter carriage, *B* to the selectors, *C* to the feed levers, and *E* to the toggle levers, by means of which the warp clamps *D* are operated to stretch the warps. *FF* are the harnesses suspended upon the old warp. *G* is a rack bar secured above the bed by means of which the knotter carriage is fed along said bed. *H* is the carriage for the old warp to which is fixed the rack bar *I* extending parallel to the rack bar *G*. This permits a play of the compensating feed mechanism whereby the old warp carriage is given a movement backward and forward to compensate for the different spacings of the threads in the two warps.

Figure 6 is a side elevation showing only the feed mechanism and selector mechanism; the other parts being omitted. $\mathcal{F}$ is a pinion secured upon the shaft of a ratchet wheel $\mathcal{F}^1$. This pinion is adapted to mesh with the rack bar *G* (see figure 5,) and by its rotation feeds the knotter carriage along the bed. *L* is a pinion of the same size and pitch as the pinion $\mathcal{F}$, said pinion *L* being secured upon the shaft of a ratchet wheel L^1.

The sensitive mechanism for feeding the knotter carriage, and for operating the compensating feed, will next be described. Inasmuch as these mechanisms are identical, the description of the first will answer for both. The sensitive feed lever *N*, of "L" shape, is pivotally mounted upon the knotter carriage *A*, in such a position that its upper end, which terminates in the offset finger N^1, encounters the foremost warp thread. The opposite end of the "L" shaped lever lies in the path of a segmental stud *O*, fixed upon the bell crank O^1, said bell crank being oscillated by means of a finger *X*, mounted upon the selector arm *P*, and bearing against one arm of the bell crank O^1. The spring O^4 tends to move the bell crank O^1 to the left against the action of the finger *X*. O^1 carries at the outer

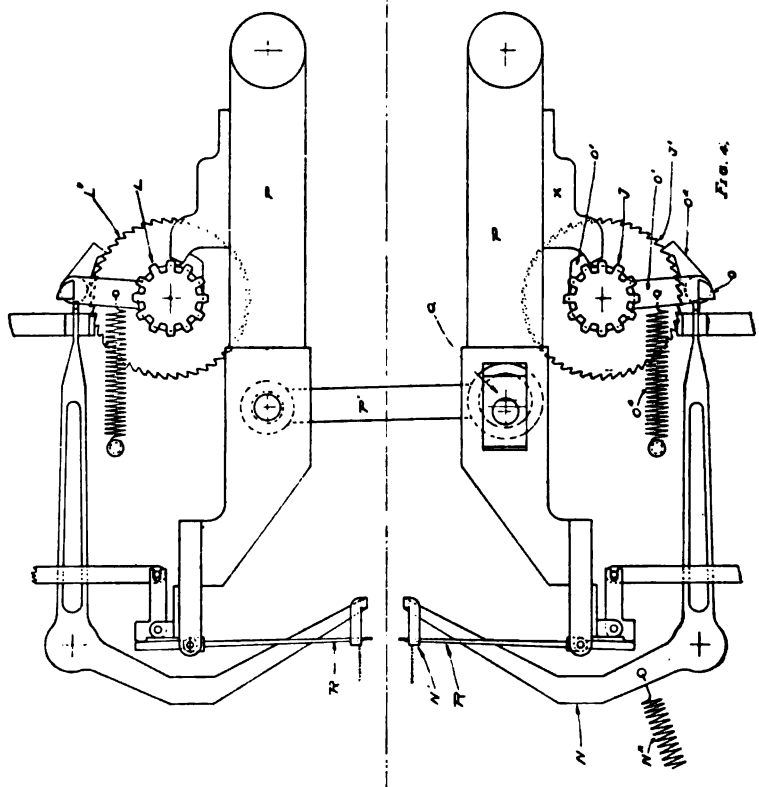


Fig. 4.

end of its other arm a pawl O^2, said pawl being adapted to engage the ratchet wheel O^3 which has a fixed connection with the pinion $\mathcal{F}$, The oscillatory movement of the pawl O^2 is not positive, and when the segmental stud O is engaged by the arm of the feed lever N, the movement of said oscillatory arm O^1 and pawl O^2 is so limited that the pawl will not take a tooth on the ratchet wheel O^3. When the finger N^1, of the sensitive feed lever N, is engaged by the warp thread, the opposite end of said lever will lie in the path of said segmental stud O, and limit the oscillatory movement of said stud and the arm O^1, so that the pawl O^2 does not take a tooth on the ratchet wheel $\mathcal{F}^1$ L^1. When no warp thread is in position to engage the finger N^1, of said feed lever N, the opposite end of said feed lever is held elevated (by the spring N^2) so that said feed lever is withdrawn from the oscillatory path of the stud O. This permits the pawl O^2, carried by the arm O^1, to oscillate sufficiently to take a tooth on the ratchet wheel $\mathcal{F}^1$ L^1 and rotate said ratchet wheel and the pinion $\mathcal{F}$. The rotation of the pinion $\mathcal{F}$ feeds the knotter carriage towards the warp threads that have not been tied, thus accomplishing the purpose of the feed.

The upper compensating feed moves the old warp carriage sometimes faster and sometimes slower than the lower feed moves the knotter carriage, but as hereinbefore stated, both are actuated by the absence of warp threads at the selectors.

The selector mechanism is also shown in this figure. The selector levers PP are oscillated synchronously toward one another by the eccentrics Q. The upper lever is connected to one of said eccentric by means of a link P^1. The forward ends of the levers PP carry the selector RR, upon the end of each of which is provided a hook R^1 (figure 7). The oscillatory movements of the pivoted selector levers PP impart a corresponding inward and outward movement to the selectors RR; the hooks R^1R^1, of said selectors, being reciprocated across the plane of the warps. The selectors move inwardly and outwardly together and their hooks engage a single thread from each warp upon each inward movement of said selectors. The

selectors are pivotally supported upon the free ends of the selector levers.

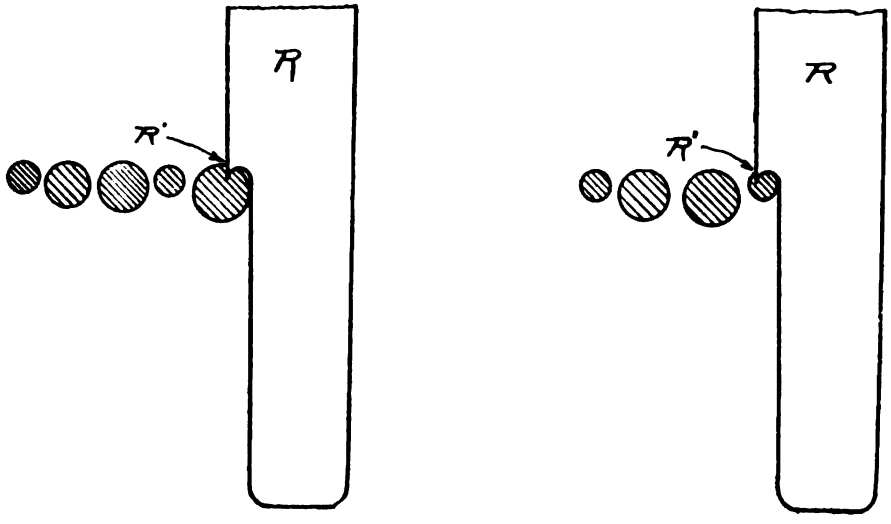


FIGURE 7. ENLARGED VIEW OF THE SELECTOR.

Figure 7 shows enlarged end of selector and indicates how a selector hook too small to take two threads will, nevertheless, take a thread much larger than normal because of its spearing action.

Figure 8, shows the piece of warp as it is taken out of the loom. The wooden clamp which is applied near the whip roll, is at the top, and the harness and reed at the bottom. The drop wires are barely visible below the harnesses.

Figure 9 is a detail view showing the means of clamping the warp threads in the clamps of the bed and those of the warp carriage. This clamp comprises a frame S, clamp bar S^1, and an operating bar S^2. The adjacent faces of the clamp bar and operating bar are provided with teeth, the inclined faces of which teeth are in contact. The toggle lever S^3, one end of which is pivotally connected with said operating bar S^2, by

FIGURE 8. PIECE OF THE OLD WARP READY TO BE PLACED IN MACHINE.

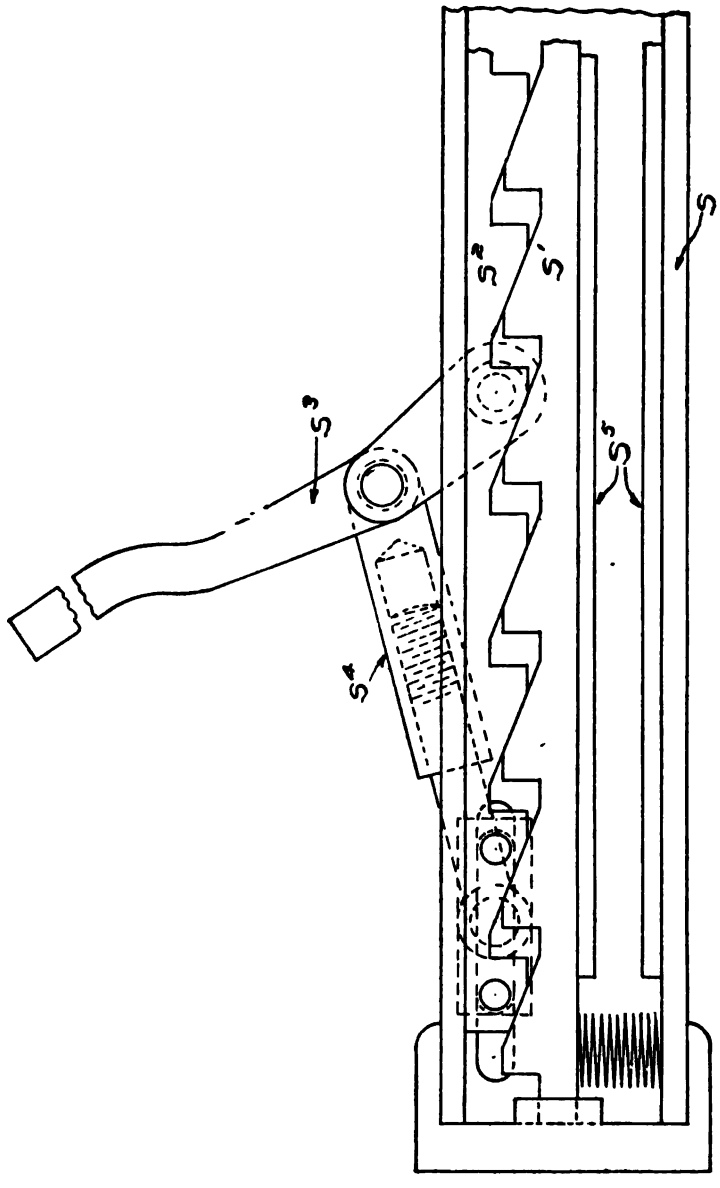


FIGURE 9. SHOWS WARP THREAD CLAMPING DEVICE.

means of the links S^4, and the other end with the clamp frame S, provides means for moving the clamp S^1. The warp to be clamped is pushed into the space between the frame S and the clamp bar S^1 by means of an insertion bar T, as shown in figure 10. When the warp upon the insertion bar is pushed between the clamp frame S and the clamp bar S^1, the toggle lever S^3 is thrown to the left (figure 9) moving the operating bar S^2 and forcing the clamp bar S^1 toward the clamp frame S. The clamp frame S and the clamp bar S^1 are faced with rubber or other yielding material S^5, so that the longitudinal ribs upon the insertion bar will be imbedded in said yielding material when the clamp is closed.

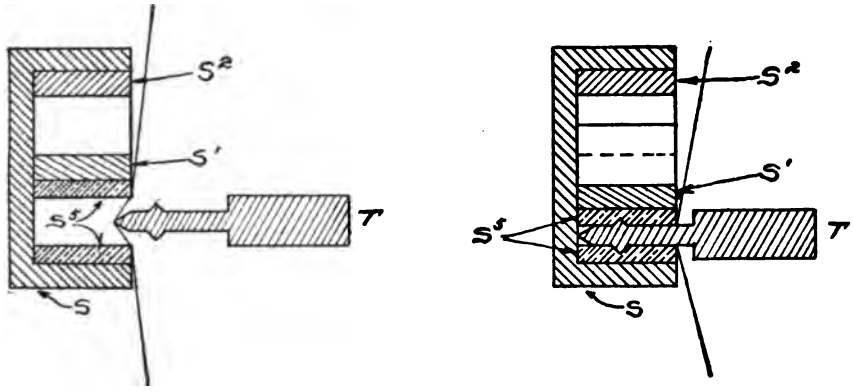


FIGURE 10. INSERTION BARS.

Figure 10 is a cross section first showing the insertion bar entering and then clamped in position.

Figure 11 is a plan view of the lower warp showing it as it is held in the clamp frames SS, by the insertion bars TT. This is also shown in figure 10. The warp is clamped in the frames SS, stretched over the ribbon U, which ribbon is then given a longitudinal movement, drawing the threads to one side and leaving them in a position better adapted to resist the pressure of the selector and feed lever than would be the case if they passed straight across.

This figure also shows the irregularity of spacing (somewhat exaggerated) that may exist in either or both warps without interfering with the proper action of the machine.

At the Massachusetts mills in Georgia, where one of these machines has been in operation for some months, the actual saving on the pay-roll is stated by the management to be $50.00 per week and in making this statement the following details were given:

In eleven hours 81.4 warps of 1,730 ends each of number 12's yarn were tied in at a cost of $7.77, which includes cost of the attendance, interest on investment, the value of waste, power and oil, as well as the cost of repairs, which equals 9.54 cents per warp as against 20.19 cents per warp by hand.

At the mill referred to as having two of these machines in operation for some considerable time, the work performed during the month of March, 1905, on the knot-tying machine cost 11.49 cents per beam, as against a cost of 28.66 cents per beam for drawing-in by the ordinary process. It is only fair to state, however, that the two machines were not in use all the time, on account of waiting for harnesses and warps, and at same time the attendants were receiving full daily wages, and I believe under normal conditions the cost should not be over 9 cents per beam.

Within the past few months several of these machines have been put in operation in various mills on different classes of goods, and in all cases there has been expressed complete satisfaction as to the work performed.

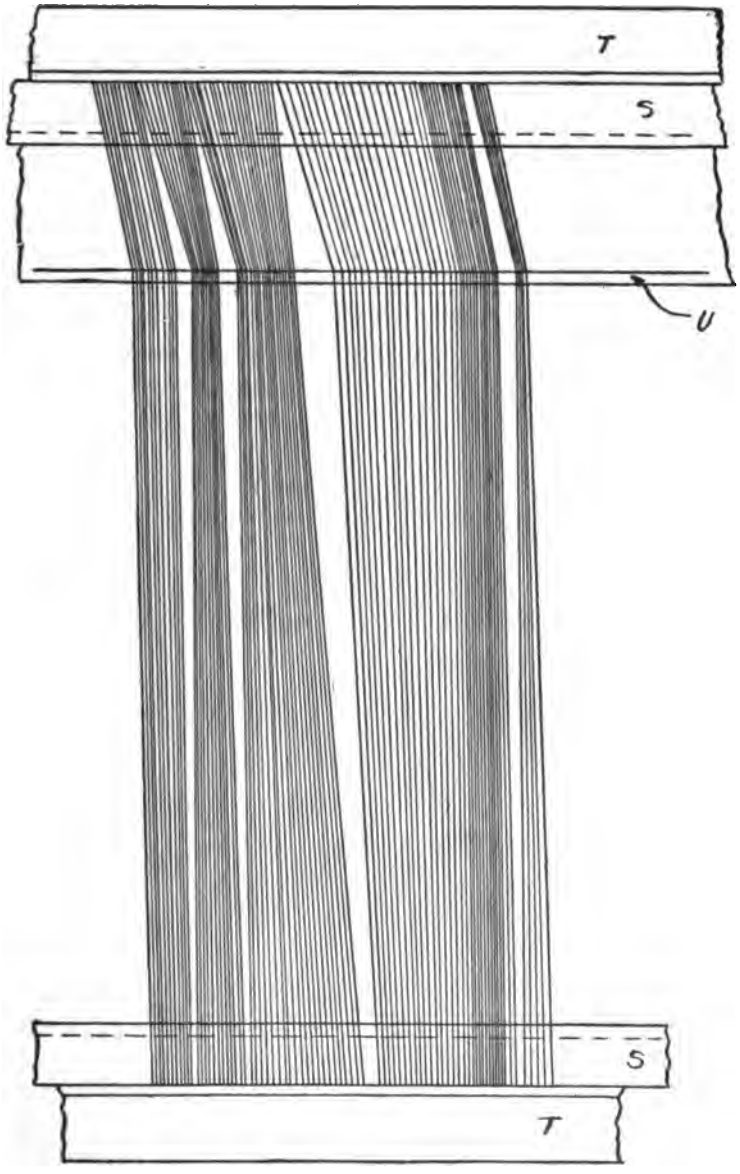


FIGURE 11. SHOWING PIECE OF WARP.

Mr. GEORGE OTIS DRAPER. I would like to ask Mr. COLMAN how often the cutters of the knotter have to be sharpened. With that excessive amount of work on the knotter I should think it might have to be sharpened or replaced quite often, and would like to know just what his experience has been in that direction.

Mr. HOWARD D. COLMAN. We anticipated quite a little difficulty on that point, and would not have been surprised if we should have had to replace those knives every day; but as a matter of fact in the Olympia Mill they run for several weeks— I never kept any record — but in the Massachusetts Mill in Georgia, where they have No. 12 yarn, they have been replacing them once a week, making the cost 25 cents a week.

The PRESIDENT. I presume, in Mr. THOMAS' absence, there would naturally not be a great deal of discussion upon his paper; but with your permission I would like to take this opportunity to say that this Association is perhaps indebted to Mr. THOMAS for the many papers that he has presented more than to any other member.

We will proceed, gentlemen, now to the next paper, Boiler Plants in Bleaching and Dyeing Mills by GEORGE I. ROCKWOOD.

BOILER PLANTS IN BLEACHING AND DYEING MILLS.

GEORGE I. ROCKWOOD, Worcester, Mass.

In some of the older centres of the New England textile industry, there may be found quite a number of large bleaching, dyeing and finishing mills which have attained their present great size and great diversity of products very gradually and hence almost unconsciously. Their original projectors never expected them to spread out as extensively as they have done and not very much attention has been paid to maintaining always the best disposition and inter-relation of their several departments and buildings. Unlike the goddess Minerva, who "Sprang full-panoplied from the head of Jove," they were of no such consequence when they were born; extreme economy was the only policy followed in purchasing new buildings and machines, and now the best that can be said of them in explanation of their inefficient organization is that no one was responsible, for, like "Topsy," they "just growed."

Such concerns, however, can no longer be let alone as they are. They feel the full force of the competition of many newly established plants, upon which the most careful study on the part of the most up-to-date managers and mill architects has been expended with a view to reducing to a minimum all unnecessary steps, processes, labor and material. What shall the managers of these ancient and inefficient properties do? Some will follow what is called a "safe" — that is, a timorous — policy, adding a "wart" of an extension to a building here, and introducing a bit of an improvement in a process there. In all things

they will, as the saying is, "walk on one shoe to save the other," a limping, slow gait at best; but in the end such a policy won't save them. The inevitable reconstruction will only be more difficult when it does come, and the capital outlay is sure to be all the greater.

Among the more important questions now arising in such mills is that of how best to re-organize and consolidate the steam generating and power department. In their series of buildings, old and new, there are generally several complete boiler and engine plants, besides a water turbine or two. The shafting runs all sorts of ways and does not exist in suitable sizes to lend itself to a central drive. Again, any concentration of the boiler plant in one spot favorable to coal-handling must be considered along with the uses to which the steam is to be put and the distances it must travel.

Steam must be supplied to the bleachery, the dye-house, the print-works, the fast-black plant. The boiler-house should be on the edge of the railroad track, or, it may be, the wharf. The products of combustion must be discharged at such a point and elevation as to insure freedom from dirt in the bleachery; while, for the same reason, the fast-black plant, though it gets its cloth from the bleachery, should not be near enough to it to discharge fumes in that direction. Without doubt — though contrary to one's first impulse — the chimney should be as close to the bleachery as it is possible to get it. Smoke never, in any state of the atmosphere, settles straight down; whereas, the smoke from a chimney situated one or two hundred yards on one side of the bleachery may quite easily soot the cloth when the breeze blows towards it and the humidity is high.

In the light of the manufacturing requirements touched upon above, an examination of the actual state of things, made by an outsider with a view to suggesting radical improvements, is likely to leave one in an exhausted and discouraged condition of mind. He feels, after seeing the menagerie of unsuitable buildings, shafting, power and boiler plants, that it is time to call in the surgeon and then start again.

As to reorganizing the power, in nine cases out of ten nothing can be done to effect much economy by concentration unless the owners will consider the expense of an electric drive. Fortunately, the power requirements of the kind of mills in question are relatively small. Many times the number of boilers needed to supply a single large engine for driving shafting are used to make steam for kiers, dry-cans, dye-tubs, ageing machines, etc. The machines to be driven are widely scattered. The cost of an electric generator and motors is relatively small; and to establish the policy of concentration made possible by the use of the electric transmission of power is of great importance to the subsequent growth or alteration of the plant as a whole. The steam turbine can only be used to drive a generator. It cannot drive direct, by ropes or belts. The steam turbine cannot be used, therefore, unless the electric drive is also used. But the turbine has an advantage, as a source of dye-house or print-works power, over the reciprocating engine in one important particular; namely, its exhaust steam is pure and uncontaminated with cylinder-oil and can be used in creating a hot-water supply in the place of live steam. The steam turbine and generator combination is very considerably cheaper in cost of installation, and is somewhat so in cost of operation, as compared with the steam engine-and-generator unit. From the writer's experience thus far with steam turbines, he would favor their purchase every time and for every place when the electric transmission of power is in itself desirable. It may be said, in passing, that electric motors should not be put up inside the bleacheries themselves, nor in any place where fumes or vapor can harm them, otherwise they may prove expensive indeed.

One reason why it is very desirable to consolidate the power in one spot is that the cost of highly paid engineers is reduced, to that of one man, and he may quite as well be the same individual as the chief engineer of the consolidated boiler house if the engine room adjoins the boiler room. In a particular mill where two or three years ago, there were 31 Corliss boilers of the older types — rolling-pin and centennial — 18 of which

were used for manufacturing purposes and the rest for power, a saving, by consolidation into one modern boiler house and steam turbine plant, was effected amounting to $75 per diem for coal and to $14.40 for reduced labor; and this with an increase of wages paid the single chief engineer of $1 per diem. Yet the greatest advantage of the consolidation to these mills was prospective rather than actual, for, in the future, they have but to extend this boiler house and turbine plant to provide any reasonable increase without further expense for a chief engineer, besides saving many minor expenses. One would invest $15,000, if necessary, to save the cost of a second chief engineer, whereas, no extra investment at all is needed if the consolidated boiler plant is of such a design as to admit of extension without its affecting the old plant already at work.

In order that one chief engineer may be able to watch effectively the daily routine of a large power and boiler plant, one thing must be uppermost in designing the original lay-out: it should be compact, and of such shape and dimensions that the engineer can easily see and speak to every fireman, coal passer, and oiler without moving about much himself. The limit to the size of a boiler plant which one man can properly oversee in this way may be placed at something over 5,000 boiler H. P. Obviously, no labor is saved by concentrating in one unit, a larger plant than can be carefully attended to by a single engineer; a self-evident truth, but it seems to have been overlooked completely by the designers of the great metropolitan electric power stations, and may be emphasized, now, as mill engineers have been turning more and more to these stations for inspiration in handling the design of the larger industrial boiler plants of the sort we are now discussing.

Just what design of boiler plant constitutes the best possible arrangement is something of a riddle. The key is found in devising a satisfactory coal-handling scheme. The plant which has the most economical coal-handling methods in use will be the most economical producer of steam; so that the answer to all other questions of design should wait until after the designer

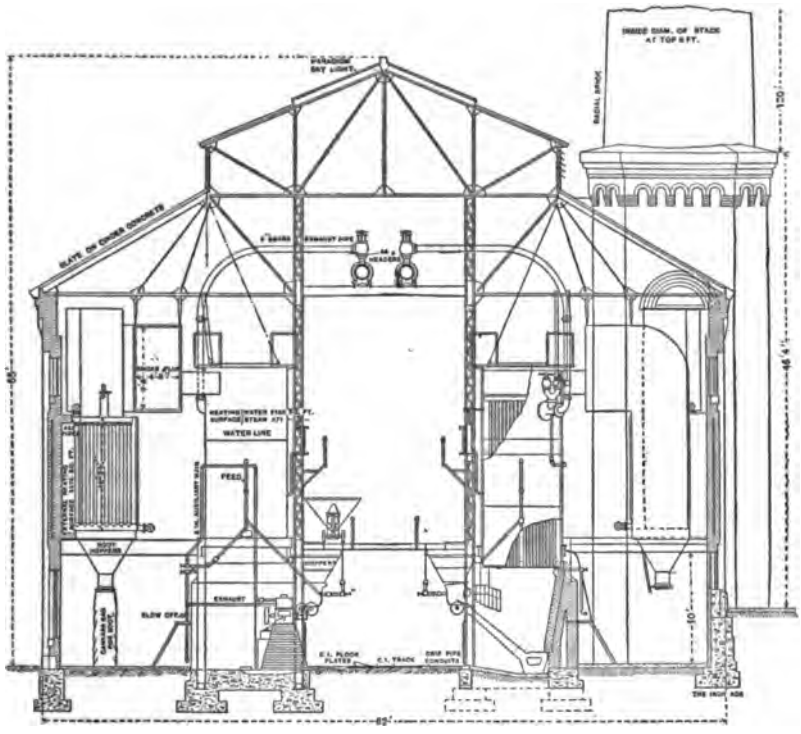
has fully convinced himself on this point. Here, too, is where the greatest difference of expert opinion lies. The question of selection between water tube and fire tube boilers, for instance, and of whether or not to use economizers, and of mechanical *versus* chimney draft, these questions are of subordinate importance and, besides, are pretty well understood. Let us therefore, consider the subject of coal and ash handling first.

There are three or four different methods in common use, but it is safe to say that the most common way found today in our New England boiler houses is to team the coal from the railroad or schooner to a coal-dump near the boiler house, and then to wheel-barrow it from the dump to the furnaces, into which it is fired by hand. This takes men. How much capital would one invest in plant and machinery to save the labor of one man? If the money can be borrowed at five per cent., that much must be saved clear anyway. The life of power machinery cannot be set at longer than twenty years for fear of its becoming obsolete then, even if not worn out; this means another five per cent. To this must be added about six per cent. for repairs, insurance, supplies and taxes. In round numbers, therefore, sixteen per cent. of the investment should not be a larger sum than the wages saved. So the safe rule is to multiply by six the wages it is proposed in any case to save by investment in machinery and buildings, and the product represents the limit of prudent capital expenditure where the purpose is solely to save wages. Judged by the application of this rule, the coal team, wheel-barrow, and human stoker combination will be found the least economical of any, except that most modern of all designs, namely, a structural steel boiler house, having an expensive steel construction for supporting the boilers, and boiler-room story above an ash-collecting floor; another story above the boiler room for economizers and smoke-flues, and, away up fifty feet in the air, a great steel and masonry coal-storage pocket served by a bucket or belt conveyer and discharging the coal by gravity, through pipes, into the hoppers of mechanical stokers. The fixed charges on such a structure will be found so great

that nothing but the most excessive cost of land — such as rules in the down-town portion of New York City — will justify it, even if that ever does. In order to go up in the air and support thousands of tons of steel, masonry and coal, one must first pay for going down into the ground to bed rock with foundations. No other natural foundations are able to hold the weight on the columns without settlements which will affect the joints of piping and machinery under steam and water pressure.

As in other cases, so in boiler house design, the true economy is found in adapting as much machinery and as expensive coal pockets — in comparison with the more simple, but too costly, reliance on man and beast power — as will return sixteen per cent. or thereabouts on the capital which pays for them; and it will be found, on investigation, that all the advantages of the modern boiler house may be had with far less expense if the coal pocket be placed directly on the ground and on one side or end of the boiler plant proper. By thus leaving the roof of the boiler house unencumbered with the coal pocket, not only is the simplest and cheapest structural-steel design possible, but a skylight over the center-isle between the boilers makes the whole boiler room light, airy and fit for a decent man to work in; whereas, some of these modern boiler rooms can only be compared with underground dungeons.

On page 251 is given the vertical cross-section, and on page 253, a plan, showing a boiler plant with coal handling arrangements partly manned, but in which no coal shovelling is done. The novelty here consists in the use of mechanical stokers served by coal tip-cars, running on tracks at a level just above small bunkers suspended directly over each stoker and holding each one ton. The capacity of two men, whose combined wages amount to $1,000.00 per annum, is 5,000 boiler horse power when pushing a car holding one ton of coal. They have to push the car an average distance of 100 feet from under a hopper in the large — 2,000 ton — coal pocket to the individual stoker bunkers. As it is impossible to operate any mechanical coal-distributing plant with less than $1,000.00 wages per annum,



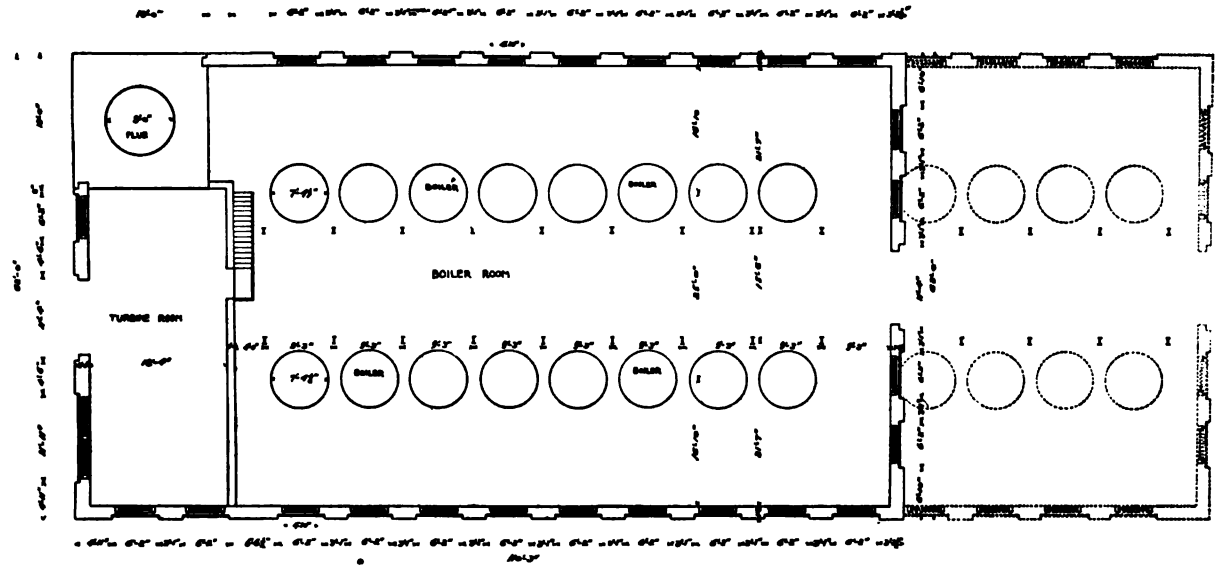
VERTICAL CROSS-SECTION.

nothing would be saved by overhead construction and gravity distribution. That is to say, men must be attending to automatic scales, or starting along the coal in the vertical coal distributing pipes when it refuses to descend. But even if the whole sum of $1,000.00 per annum could be saved by overhead construction, this, by the rule, would permit a maximum expenditure of $6,000.00 — a sum totally inadequate.

A coal-pocket built directly on the ground and enveloped by a bucket conveyor could be made entirely of wood, tied together with iron rods. If placed over the boilers it must be of steel and lined with concrete or brick. In the coal pocket of the plant shown, the conveyor passes right around the pocket

endwise, and (1) may be used for emptying the bin into which the electric coal cars discharge their loads and conveying the coal up and into the pocket at any desired point longitudinally; or, (2) it may be used for turning over the pile from the bottom to the top in the event of heating; or, (3) it may be used to elevate the daily supply of coal for the boiler house into an isolated bin at a high elevation, from which it may be drawn by gravity into the coal tip-cars, as stated above, for distribution to the stokers. A 2,000 ton pocket, exclusive of the land, costs completed, with coal crusher, conveying machinery, electric motors for driving them, receiving hopper foundations, and elevated bins, about $20,000. Its advantages over a mere dump are (1) it enables coal to be received in storage without either a first or second shovelling; (2) it stores coal economically as to extent of land; (3) the conveyor saves the coal in case of spontaneous combustion; (4) the conveyor permits accurate measurement of mixtures of anthracite with bituminous coal; (5) the elevated bins from which the tip-cars get their supply by gravity, are filled from the pocket by the same conveyor. Fire is less likely to occur by spontaneous combustion in a wooden pocket than in the tight steel pockets of the kind necessary if put over the boilers, because the sides and bottom of the wooden pocket are open slightly between the planks, thus aerating the coal. If the coal does catch fire it is easier to extinguish it, and the wooden lining is cheaper to renew. A pocket is of advantage near a bleachery because it limits the flying coal dust.

The desirability of purchasing automatic stokers is a very much discussed subject. Certainly they will not pay if their use is unaccompanied by mechanical means for filling their hoppers. How often does one see in a mill plant any attention paid to this point! We have often seen stokers put in with great expectations of economy of labor and coal; and the fireman is also expected to shovel every pound of coal seven feet up into the hopper from the boiler room floor. How much attention is a fireman likely to spend on the ecomical working



— FLOOR PLAN —

SCALE ¼ INCH = ONE FOOT

826
1

of the machine when coaling it is attended with so much laborious effort? With the method of coal handling shown in the illustration, which is useless without stokers, the mere saving in labor is sufficient to warrant their use; and, if operated as intended and as they may be seen operating in many large plants, stokers will save coal over the best ordinary hand firing, especially when working with bituminous coal.

With regard to the best type of boiler, we have no fault to find with the kind — upright firetube — shown in the illustration. A preference for this type is based on its price, $7.50 a horsepower erected, its compactness, the ease with which tubes may be swept, and the fact that it gives superheated steam. It is a great steamer, and there is nothing to choose between its economy and that of any other correctly designed boiler and furnace. The boiler shown is seven feet diameter, ¾ inch shell with quadruple-riveted butt-strap joints. It is supported on a steel frame work, independently of the brick furnace. It is desirable, however, that only clean, soft water shall be fed to a boiler of this type. If scaly waters are to be used, the B. & W. or Sterling water-tube boilers are to be preferred.

Economizers are frequently omitted from otherwise first-rate plants. This, however, is unquestionably a mistake, as they take the place of just so much heating surface, if similarly placed in the boilers, and deal with comparatively cool water which could not be dealt with in a boiler so effectively. It would be better to deliberately install fewer boilers and supplement them with economizers, than to try to do the whole work with boilers. 600° or even 650° Farhenheit are not too hot for the gases as they issue from the boilers, where economizers are used; yet 400° to 500° are much more common figures. Economizers save about 9 per cent. of the total fuel bill. In a certain plant the economizers cost, completely installed, and making due allowances for the extra cost of the boiler house because of their presence, something less than $15,000. The coal burned per annum is about 15,000 tons, which at $3 a ton, equals $45,000. Nine per cent. of $45,000, = $4,050, which is

27 per cent. of their cost, or 11 per cent. more than the 16 per cent. necessary according to the rule given above.

Mechanical draft versus chimney draft is another question not fully settled in the minds of experts. For bleacheries, however, both should be provided. The chimney is needed because the soot must be discharged at a high altitude to avoid contact with white goods. By means of the fan a smaller installation of boilers will do the work of supplying sudden demands of dye-house or bleachery for gusts of steam for an hour or two, than would otherwise be required. This is much the more economical scheme as compared with the large reservoir of hot water idea, embodied in a much larger boiler plant than the fan would make necessary and working the greater part of the day very lazily under a light chimney draft, simply to be there when the heavy demands for steam come. It is not, apparently, generally realized that a stoker grate is more durable under a heavy fire than under a light one; and sudden changes from heavy fires to light ones cause the grate to burn out very fast. Again, a mechanical draft system costing $5,000 installed will do the work of 16 — 220 horse-power boilers with 12; the 16 having only a 175-feet stack. Each boiler, with its full equipment and building, costs about $8,000. The difference between 16 and 12 is 4 boilers saved, or $32,000. Thus there can be no question as to the desirability of providing both chimney and fan in this class of boiler plants; and the same thing has been found true in large electric power plants.

Few owners realize when they commence construction what a large proportion of their cost will go for piping and pipe-covering. It is of the first importance, then, that it be well done from first to last, and by an experienced hand. One advantage resulting from the very flexible suspension of the boilers in the illustration is in the tightness of the headers and flanges in the steam mains. The boilers can follow, to a slight extent, the motions of these mains.

Boilers in textile mill plants are still very rarely connected up to their mains in such a manner as to avoid water pockets;

and the special advantage to mills of perfect natural drainage is that it affords the night fireman more complete security and ease in "cutting in" boilers after internal cleaning, as he "fires up" for the morning start. Often the region around the main valves is very dark, hot, dirty and accessible only by means of a rickety ladder, and it is a matter of considerable danger to open drain cocks and connect up the boilers and main. All this is unnecessary, and avoidable by forethought in the general lay-out of building and piping. In the case of the plant illustrated, the night fireman frequently "cuts in" a delinquent boiler with as much as twenty pounds difference in pressure, and without a snap or a pound.

The building should, of course, be fire-proof. Not only should all trusses be of steel, to avoid stresses on pipe lines and machinery due to the shrinkage of wood, but the roof itself should be of some durable fire-proof, non-shrinkable and non-corrosive material. Cinder-concrete and expanded-metal are as good as anything. Slate may be nailed directly to the concrete, if done before it is too dry and hard.

A carefully planned boiler house, designed with compactness and symmetry in the disposition of every detail, conduces not only to ease in management but also to reducing the necessary size and cost of land and building. The most careful study should be given, in designing the cross section, so as to stow everything as snugly as possible, without interfering with room enough to enable the apparatus to be easily cared for and repaired. If the necessary time and thought are put into such study, it is surprising how many general, as well as minor, modifications may be introduced into the first draft before the best and cheapest design is hit upon.

It should be recognized from the first that a boiler house is an expensive kind of a mill building, and that, therefore, full information as to the kind and size — present and future — and arrangement of boilers should be known before erecting the building to contain them. In fact, the building and machinery should fit each other as exactly as the propelling machinery fits

the hull of a ship; only in that way can the greatest economy of first cost and subsequent maintenance be achieved. Moreover, as the boiler house is where the money is being spent every day, the designer should bear in mind that it is not merely a place of incarceration for "Fenians"; on the contrary, a higher class of "help" must be employed in the future than hitherto. There should be plenty of light everywhere, with no dark corners anywhere, and a state of cleanliness should prevail here as well as in the engine room. Cleanliness, with a good supply of white-wash, in the boiler room is the handmaiden of economy; for it reveals cracked boiler settings, leaky pipes, and shiftless firemen.

The PRESIDENT. Does anyone desire to ask Mr. ROCKWOOD any questions?

Mr. WILLIAM D. HARTSHORNE. Mr. President, there is one point I notice in Mr. ROCKWOOD'S paper, — in regard to the use of wood structures for coal pockets, and the reason given for preference, "Fire is less likely to occur by spontaneous combustion in a wooden pocket than in the tight steel pockets of the kind necessary if put over the boilers, because the sides and bottom of the wooden pockets are open slightly between the planks, thus aerating the coal. If the coal does catch fire it is easier to extinguish it, and the wooden lining is cheaper to renew."

In our mill it has proved quite the reverse. I have never known a case of spontaneous combustion except in wooden pockets.

Mr. GEORGE I. ROCKWOOD. That opinion was handed out to me, and I agreed to it more on theoretical grounds than from my own experience. It was the opinion of JOHN A. MEAD, and it was said that nearly all the combustion fires happened in the

steel coal pockets; that the wooden pockets could not get afire on the bottom because of the spaces between the planks. But if they do, it is a comparatively cheap thing to renew them; it is outside on the ground; it does not shut down your boiler-house or affect your operations; and being so very, very much cheaper it seemed to me it was better for such plants as you would find in textile manufacturies than the more expensive steel and concrete construction.

Mr. C. J. H. WOODBURY. There may be another point that has tended to increase the number of fires in these iron and concrete coal bins, and that is that they are made à great deal stronger than those of timber, and therefore able to sustain a very much greater depth of coal.

The spontaneous ignition of coal is due to several conditions, one of which is that it is favored by great pressure; which prevents the radiation of much of the heat from the oxidation of the inorganic compounds of sulphur, as would be the case in a shallow pile of coal.

The spontaneous ignition of coal is a rather complex process, and some years ago I had occasion to look into that subject, beginning from the mines and up almost to the boiler door, and the starting of the ignition of a spontaneous coal fire is generally attributed to the amount of sulphur. Now while it is true that sulphur is the inciting cause, yet it should not be overlooked that sulphur exists in bituminous coal in two forms, — first, in organic combinations which do not oxydize naturally, and are not a source of hazard; and, secondly, the inorganic combinations, which do oxydize, and it is these which oxydizes and produce the excessive heat causing ignition.

And the hazard of the coal is not measured either even by that matter of the percentage of sulphur in combination as pyrites, because in some coals where there is a relatively large amount of sulphur which is uniformly disseminated throughout the whole mass or vein, that such coal will be immune from any hazards of that kind. In others it is very irregular, and the

hazard is that of the greatest concentration; which may occur in a small lump.

The heating by the oxydation of the pyrites I do not believe will ever produce a sufficiently high enough temperature to ignite the coal directly; but there must be some go-between, it may be a leaf, a chip, a piece of shavings, or any easily combustible material. The sequence of the process is very much as in the old-fashioned sulphur friction match, where the phosphorous compound is warmed up by the scratching of the match sufficiently to burn, and this flame lights the sulphur which is on the wood, and the burning sulphur in turn ignites the wood.

And so in the coal pocket where the fire is started there is some easily combustible go-between between the pyrites and the coal, which is comparable to that of the sulphur on the match between the phosphorus compound and the wood.

Mr. WILLIAM D. HARTSHORNE. That is exactly as it lies in my mind, — in conformity with my experience. We have a coal pocket built of wood, and the overhead rigging for carrying the coal is supported on wooden bents whose legs come to the bottom of the pocket.

We have had cases of spontaneous combustion occurring a good many times in that pocket, but in every instance it was traced to where there was a contact with wood material. The bottom of these legs was the favorite place for the fire. It is true also that even in a comparatively low pile, where light chip material and water were present, we have known cases of fire to take place.

FOURTH SESSION.

THURSDAY AFTERNOON APRIL 27, 1905.

The Association met in Chipman Hall at 2.30 P. M., President WALMSLEY in the chair.

The PRESIDENT. The first paper for this session is by Mr. SIDNEY B. PAINE of Boston, on the Progress in the Development of the Electric Drive.

Mr. SIDNEY B. PAINE. In presenting this paper I have purposely confined myself to one phase of the subject, and in order to illustrate it I have used the results obtained by a continuous test for a week in a ring spinning room.

PROGRESS IN THE DEVELOPMENT OF THE ELECTRIC DRIVE.

As exemplified by a week's test on spinning frames.

SIDNEY B. PAINE, Boston, Mass.

"The scrap heap is the foundation of American progress." It expresses most eloquently dissatisfaction with present attainment. It proclaims that that which has been accomplished is merely a step in the progress of development. The history of the textile industry bears abundant witness to the truth of this statement. Recognizing its force, you have offered every encouragement to the inventor to put forth his best efforts. You have afforded him every facility to explain his invention before practical men. By your suggestions and advice you have assisted him in its perfection. It is this liberal and progressive spirit which has placed America in the front rank of manufacturing countries.

In April, 1895, it was my privilege to present a paper before this Association on "The Electrical Driving of Textile Establishments."* In that article a general description was given of the system and methods which had been adopted in the first textile mill in this or any other country, to be driven electrically throughout. At that time, this first mill had been running about nine months. It is a pleasing coincidence that at the present meeting we are to have a report from this mill. Much

* Transactions, New England Cotton Manufacturers' Association, Vol. 58, p. 216.

progress has been made during these ten years. The writer has a record in detail of 128 different textile corporations which are using about 90,000 horse power of electric motors. It is a conservative estimate that approximately 175 textile mills in this country are using electrically about 140,000 horse power. The census of 1900 showed that 1,165,048 horse power was used by the cotton, woolen, worsted and silk mills in the United States. Assuming an increase in the last five years of 25 per cent. we find that about 10 per cent. of all the power used in these industries is obtained from motors. When we consider the fact that, at the outset, the electric system was as new to engineers as to the manufacturers, we can understand why the progress has not been even more marked. It may be of interest to analyze the above 90,000 horse power of which the above record has been kept in detail. Fifty-four thousand (54,000 h. p.) horse power is generated by steam, 33,000 horse power by water-power and about 3,000 horse power by water and steam combined. Forty-two (42) new mills have been built in which the electric drive was adopted at the outset. In 28 of these 42 mills, the energy is generated by steam and in 14 by water-power. Most significant, however, is the large number of mills which are operated from central power stations. Twenty-two (22) mills are thus driven entirely by current generated by an outside and independent corporation, while twenty-two (22) mills purchase 5,586 horse power to supplement the power generated upon the premises. This indicates very clearly the tendency toward "Centralization of Power," which the writer has advocated for several years. This movement has not been confined to this country, for in England two large power companies have been organized, in Yorkshire and Lancashire respectively, which are soliciting business from the textile mills. Two years ago a prominent English manufacturer remarked to the writer, "We have been watching your progress in America, and believe that your experimental work is nearly completed. We are about ready to adopt your system." The signs are not lacking that they are on the eve of a forward movement in this direction.

In all its essentials, the system followed today is the same as that adopted ten years ago. In some few details, improvements have been made. The principal change has been in the direct connection of the motor to the spinning room shaft. In the first mills this arrangement was adopted for the picker room only. There has been a marked advance, however, in the recording and indicating instruments. At first we had to depend upon the ammeter and voltmeter. The use of these instruments was found to be unsatisfactory, as the readings of the ammeter had to be corrected by the readings of the voltmeter, and did not even then give a correct indication of the amount of energy furnished by the motor. The use of the indicating wattmeter corrected this difficulty, but no continuous record could be kept by that instrument. Then followed the curve drawing wattmeter, by which the record was drawn by a pen on a revolving disc. This was open to the objection that its record, especially on light loads, was too short to be of much service. The latest instrument to be developed is the registering wattmeter, by which the record is drawn upon a strip about 3 inches wide, as the rate of 3 or 6 inches per hour, as may be desired. The duration of this record depends upon the length of the strip.

The several charts given below are photographs of results obtained during the test of a fine goods mill. The speed on each strip was such that 3 inches passed under the pen in one hour. From this may be determined the scale to which the camera has reduced the record. *Fifty (50) such continuous curves were taken in this mill, each representing the record of half a day. In addition, five special tests of shorter duration were made. A recording wattmeter was also connected in the circuit to record the total energy, and an indicating wattmeter was used to give instantaneous readings at ten minute intervals and to check the registering wattmeter. Careful record was

* It is unfortunate that the limited space has required the reduction shown. It is hoped, however, that the curves as reproduced will be sufficiently legible to be of service.

made of temperature outside and also inside the mill and of the humidity both relative and actual. Memorandum was made of all particulars connected with the machinery driven. Great difficulty was experienced in determining the actual number of machines in operation at a given moment, but especial care was used to have the record as accurate as possible. The curves given below are the record of a run for a Saturday morning and the first five days of the following week, of a 200 horse power motor in a ring spinning room, and indicate the current delivered to that motor during the period. The "friction load," so called, was ascertained for comparative purposes only, as it cannot be accepted as giving the *actual* efficiency of the drive, for, as has been explained several times by the writer, it indicates merely the energy consumed under conditions which do not prevail when the machinery is in operation. When the belts are on the loose pulleys, the stress and torsion on the shafting and the slipping and especially the creeping of belts are quite different from what they are when all the machinery is running. The writer knows of no method which can determine accurately the friction losses of a system, either mechanical or electrical, under working conditions. As stated, the friction load tests do have a comparative value, however, for they detect any change or undue loses from day to day. No importance has been attached to the tests of portions of machinery to determine the power required for a single frame or number of frames. Such a test depends for its value upon the assumption that all the machines of the same description consume the same amount of power. This is manifestly an incorrect hypothesis, especially on spinning frames. What we are all interested in, is the amount of power required to run a room or a section containing a given number of spindles, together with the necessary shafting and belting.

This series of tests was made for the writer by Mr. W. L. BRADLEY, under the supervision and direction of Mr. F. B. PERRY. The 200 horse power motor under test operated 52 frames, aggregating, 11,648 spindles. The spindle speed was

supposed to be 9,000 revolutions per minute, but at that time we had no instruments suitable for determining the accuracy of this assumption. The gauge was 2¾ inches, diameter of the ring 1½ inches, and the traverse 6 inches. During this test

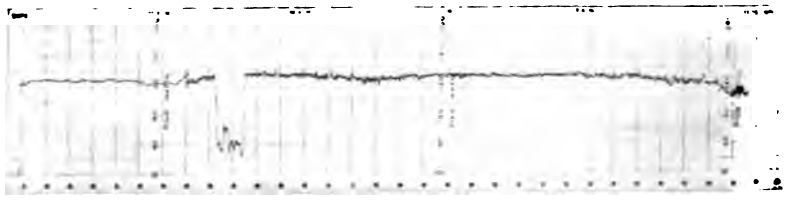
1	frame	spun	No.	40	yarn,
7	"	"	"	50	"
9	"	"	"	60	"
8	"	"	"	65	"
18	"	"	"	70	"
5	"	"	"	80	"
4	"	"	"	100	"

The current delivered *to* the motor was recorded on the curves in kilowatts. From these curves have been calculated the *output* of the motor in horse power. During the tests, readings were taken at ten minute intervals on the indicating wattmeter, but in the tables which follow, only those readings are given where a change occurred in the number of frames in operation.

With these explanations, an examination of the records may be of interest.

TEST No. 37.

Saturday forenoon, November 5, 1904.

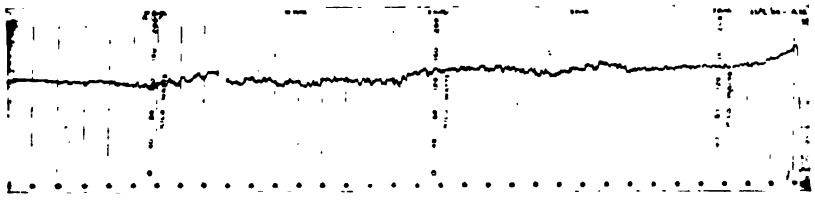


Weather cloudy.
Average temperature outside, 43°.
" " inside mill, 90.1°,
" relative humidity inside mill, 31.6 per cent.
" actual " " " 4.65 grains per cubic foot.
Maximum output of motor, 186 horse power.
Minimum " " 124 "
Average " " 154.5 "
Ratio average load to maximum, 83.1 "
" " " motor rating, 77.3 per cent.

Time A. M.	Frames running.	Time A. M.	Frames running.
7.00	35	9.50	51
7.10	45	10.00	52
7.20	49	10.26	friction load.
7.30	50		taken.
7.40	52	10.50	50
7.50	49	11.00	51
8.00	52	11.10	46
9.10	51	11.20	49
9.20	49	11.40	50
9.30	48	11.50	51
9.40	49	12.00	45

TEST No. 38.

Monday forenoon, November 7, 1904.



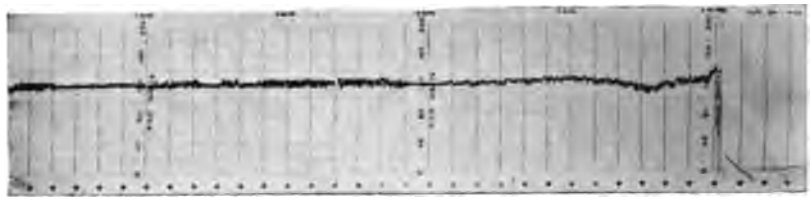
Weather cloudy.
Average temperature outside, 40.4°.
" " inside mill, 85.9°.
" relative humidity inside mill, 36.8 per cent.
" actual " " " 4.9 grains per cubic foot.
Maximum output of motor, 190 horse power.
Minimum " " 144 "
Average " " 157 "
Ratio average load to maximum, 82.7 per cent.
" " " motor rating, 78.5 "

Time A. M.	Frames running.	Time A. M.	Frames running.
6.28	52	9.40	47
6.30	51	10.00	46
6.40	49	10.20	48
6.50	48	10.30	47
7.40	47	10.32	friction load.
7.50	49		taken.
8.00	48	10.40	50
8.30	50	10.50	46
8.40	51	11.10	45
8.50	52	11.20	48
9.00	51	11.40	49
9.10	50	11.50	50
9.20	46	12.00	49

It is interesting to note that the power required to operate 48 frames at 6.50 A. M., was about 25 horse power (or nearly 18 per cent.) more than at 11.20 A. M.

TEST No. 39.

Monday afternoon, November 7, 1904.



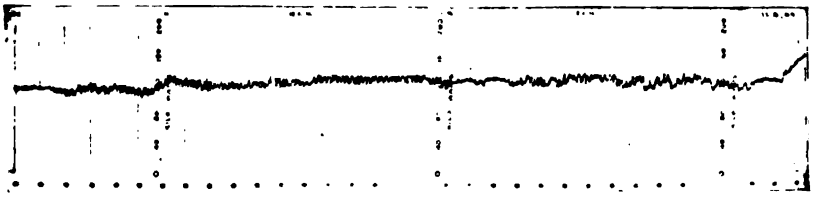
Weather clear.
Average temperature outside, 43.6°.
" " inside mill, 91.3°.
" relative humidity inside mill, 32.6 per cent.
" actual " " " 4.96 grains per cubic foot.
Maximum output of motor, 162.5 horse power.
Minimum " " 141.3 "
Average " " 149.5 "
Ratio average load to maximum, 92 per cent.
" " " motor rating, 74.8 per cent.

Time P. M.	Frames running.	Time P. M.	Frames running.
12.57	52	2.30	50
1.00	51	3.20	51
1.20	49	3.27	friction load.
1.30	47		taken.
1.40	48	3.30	52
1.50	52	5.10	51
		5.20	50
		5.59	49

On this test 52 frames required 144 kilowatts to start, as against 168 kilowatts for the same number of frames during the morning test (No. 38).

TEST No. 40.

Tuesday forenoon, November 8, 1904.

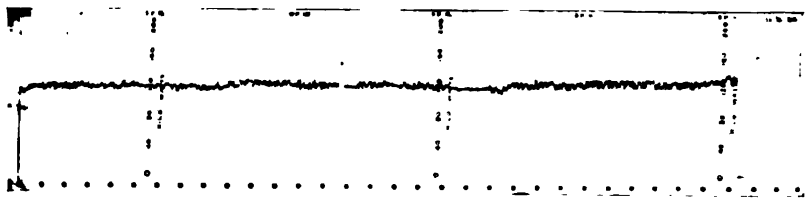


Weather clear.
Average temperature outside, 46.3°.
" " inside of mill, 90.4°.
" relative humidity inside of mill, 33.8 per cent.
" actual " " " 5.01 grains per cubic foot.
Maximum output of motor, 186 horse power.
Minimum " " 137.5 "
Average " " 152 "
Ratio average load to maximum 81.8 per cent.
" " " motor rating 76 "

Time A. M.	Frames Running.	Time A. M.	Frames running.
6.27	51	9.10	52
6.40	45	10.00	47
6.50	43	10.10	49
7.00	45	10.13	friction load.
7.10	47		taken.
7.20	50	10.30	48
7.30	48	10.40	47
7.50	50	10.50	51
8.00	51	11.00	48
8.10	52	11.10	45
8.20	50	11.20	47
8.30	48	11.40	45
8.40	52	11.50	47
9.00	49		

TEST No. 41.

Tuesday afternoon, November 8, 1904.



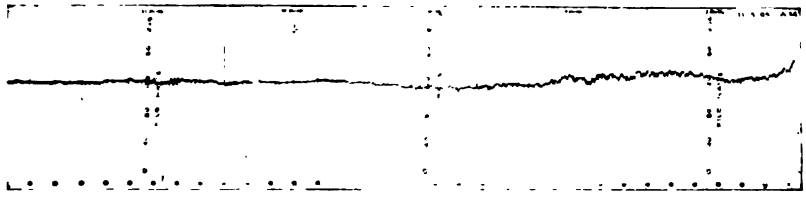
Weather clear.
Average temperature outside, 49.7°.
" " inside mill, 98.2°.
" relative humidity inside mill, 29.2 per cent.
" actual " " " 5.31 grains per cubic foot.
Maximum output of motor, 167.5 horse power.
Minimum " " 144 "
Average " " 149.5 "
Ratio average load to maximum, 89.3 per cent.
" " " motor rating, 74.8 per cent.

Time P. M.	Frames running.	Time P. M.	Frames running.
12.57	50	3.30	51
12.59	51	3.42	friction load taken.
1.00	52	4.10	52
1.10	51	4.30	50
1.30	52	4.40	51
2.10	50	4.50	52
2.20	51	5.20	49
2.40	50	5.30	50
3.10	51	5.40	51
3.20	52	5.58	48

At 12.57 the input was 140 kilowatts with 51 frames running, while at 1.30 with 52 frames the input was only 130 kilowatts. At 5.55 the input with 51 frames was 124 kilowatts, or 16 kilowatts (approximately 20 horse power) less than at 12.57 with the same number of frames.

TEST No. 42.

Wednesday forenoon, November 9, 1904.

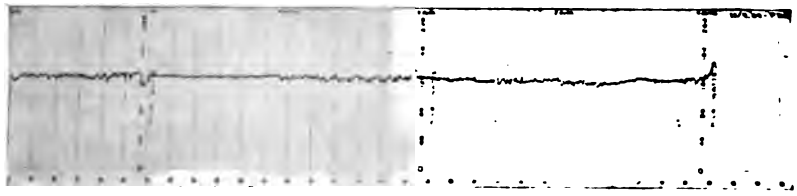


Weather cloudy.
Average temperature outside, 37.4°.
" " inside mill, 94°.
" relative humidity inside mill, 34.8 per cent.
" actual " " " 5.67 grains per cubic foot.
Maximum output of motor, 174 horse power.
Minimum " " 135 "
Average " " 152.5 "
Ratio average load to maximum, 87.7 per cent.
" " " motor rating, 76.3 "

Time A. M.	Frames running	Time A. M.	Frames running.
6.30	52	9.20	47
6.35	49	9.30	46
7 10	50	9.40	51
7.20	52	10.00	49
7.40	51	10.17	friction load.
8.00	49		taken.
8.20	46	10.20	50
8.30	47	10.30	51
8.40	46	10.40	52
8.50	43	11.30	51
9.00	45	11.50	52

TEST No. 43.

Wednesday afternoon, November 9, 1904.

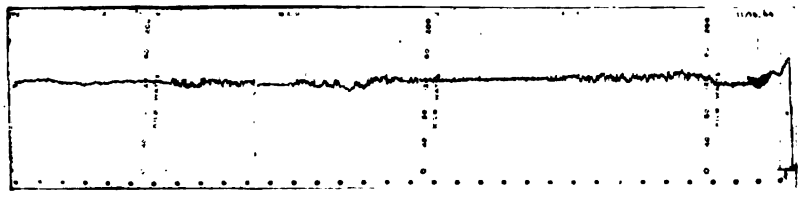


Weather rainy.
Average temperature outside, 38.9°.
" " inside mill, 94.5°.
" relative humidity inside mill, 33.4° per cent.
" actual " " " 5.56 grains per cubic foot.
Maximnm output of motor, 162.5 horse power.
Minimun " " 142.5 "
Average " " 152 "
Ratio average load to maximum 93. 6 per cent.
" " " motor rating 76 "

Time P. M.	Frames running.	Time P. M.	Frames running.
1.00	50	2.50	49
1.10	48	3.00	52
1.20	49	3.05	friction load.
1.30	48		taken.
1.40	46	4.00	51
2.00	47	4.10	52
2.10	48	5.20	51
2.20	49	5.30	52
2.40	51		

TEST No. 44.

Thursday morning, November 10, 1904.

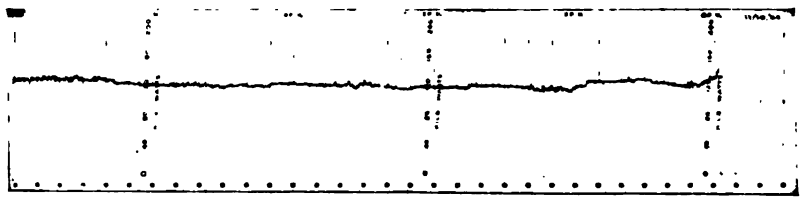


Weather clear.
Average temperature outside 43.9°.
" " inside mill, 92.2°.
" relative humidity inside mill, 34.4 per cent.
" actual " " " 5.43 grains per cubic foot.
Maximum output of motor, 178.8 horse power.
Minimum " " 144 "
Average " " 154.5 "
Percentage average load to maximum, 86. 4 per cent.
" " " motor rating, 77.3 "

Time A. M.	Frames running.	Time running.	Frames running.
6.30	50	9.40	46
6.35	48	9.50	48
6.40	43	10.00	49
7.00	44	10.10	48
7.10	49	10.15	friction load.
7.20	50		taken.
8.00	52	10.50	50
8.40	51	11.00	51
8.50	50	11.10	50
9.00	49	11.20	49
9.10	50	11.30	48
9.30	47	11.40	50
		11.50	51

TEST No. 45.

Thursday afternoon, November 10, 1904.

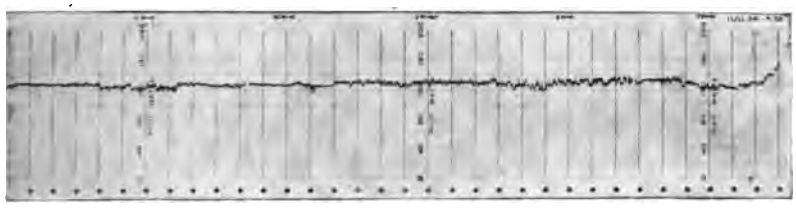


Weather clear.
Average temperature outside, 51°.
" " inside mill, 96°.
" relative humidity inside mill, 31 per cent.
" actual " " " 5.6 grains per cubic foot.
Maximum output of motor, 162.5 horse power.
Minimum " " 139.5 "
Average " " 148.5 "
Ratio average load to maximum, 91.4 per cent.
" " " motor rating, 74.3 per cent.

Time P. M.	Frames running.	Time P. M.	Frames running.
1.00	50	3.22	friction load.
1.10	47		taken.
1.30	51	3.30	50
1.40	50	3.40	49
2.00	47	4.00	50
2.20	46	4.10	49
2.30	48	4.20	51
2.50	46	4.30	49
3.00	47	4.40	51
3.10	45	5.10	52
3.20	47		

TEST No. 46.

Friday forenoon, November 11, 1904.



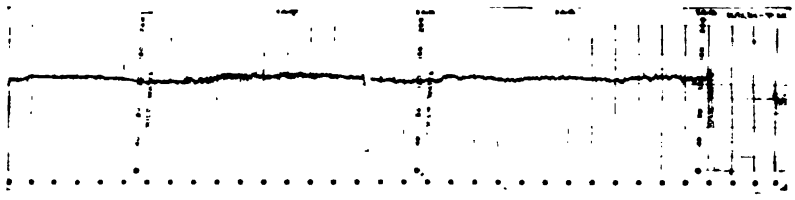
Weather, rain and snow.
Average temperature outside, 37.9°.
" " inside mill, 95.6°.
" relative humidity inside mill, 30.96 per cent.
" actual " " " 5.42 grains per cubic foot.
Maximum output of motor, 180.5 horse power.
Minimum " " 146.5 "
Average " " 155 "
Ratio average load to maximum. 85.9 per cent.
" " " motor rating, 77.5 "

Time A. M.	Frames running.	Time A. M.	Frames running.	Time A. M.	Frames running.
6.30	50	8.00	51	9.40	51
6.35	47	8.10	48	10.00	50
6.50	46	8.20	50	10.17	friction load.
7.10	50	8.30	51		taken.
7.20	51	8.50	52	10.40	51
7.30	50	9.00	51	10.50	49
7.40	51	9.10	50	11.20	51
7.50	50	9.20	51	11.30	52
		9.30	52	11.57	50

Note that at 6.30 the input for 50 frames was 152 kilowatts, while at 11.55 the input for 52 frames was only 130 kilowatts.

TEST No. 47.

Friday afternoon, November 11, 1904.



Weather, cloudy and damp.
Average temperature outside, 40.2°.
" " inside mill, 93.4°.
" relative humidity inside mill, 30.4 per cent.
" actual " " " 5.04 grains per cubic foot.
Maximum output of motor, 158.3 horse power.
Minimum " " 145 "
Average " " 152.3 "
Ratio average load to maximum, 96.2 per cent.
" " " motor rating 76.2 "

Time P. M.	Frames running.	Time P. M.	Frames running.
1.00	47	3.30	51
1.10	48	3.40	52
1.20	49	4.10	51
1.40	48	4.20	52
1.50	50	4.30	50
2.00	51	4.40	49
2.20	50	4.50	50
2.40	51	5.00	48
2.50	52	5.10	51
3.00	49	5.20	52
3.20	50		

3.24 friction load taken.

Omitting consideration of the test on Saturday (No. 37) (inasmuch as the test did not commence until 7 A. M.) the following facts may be deduced from the results obtained on the five days of the following week.

	Percentage of Machinery In Operation.		Spindles per H. P.	
	A. M.	P. M.	A. M.	P. M.
Monday,	93.6	94.6	69.41	75.97
Tuesday,	93.9	98.4	71.97	76.67
Wednesday,	95.1	97.1	72.64	74.37
Thursday,	94.2	94.6	71.04	74.21
Friday	96.3	96.7	72.32	74.03
Average for five days,	94.6	96.3	71.48	74.61
Total average,	95.4		72.95	

The results obtained in these tests illustrate the difficulty, to say the least, which would be experienced in an attempt to obtain similar information by means of indicator cards taken at the engine cylinder. The power required to operate machinery varies from day to day and even between forenoon and afternoon of the same day. If all the frames were in operation at the time of the test, the result would be misleading, as it would be more favorable than if normal conditions had prevailed. Undoubtedly the methods followed in the tests submitted herewith may be improved as more experience is obtained, and other deductions may be made than those noted above. The advocates of the electric system believe that by its use much valuable information may be obtained and that thereby the manufacturer can keep himself informed as to what is transpiring within his mill.

Mr. SIDNEY B. PAINE. I have here the records of this test (indicating), the records of themselves take these two volumes. This (indicating) is a full size curve taken by the instrument,

and you can see the fluctuations caused by the variable power in the mill.

This (indicating), representing a half a day's run, is much more legible than the little curves given in the paper.

These curves are in a continuous roll, and can be handed in every morning or every half day, as you desire, to the superintendent, who can investigate stoppage of machinery, and from the friction curves he can determine whether the belts are too tight or not, or whether the shafting is out of line or improperly oiled.

The extent of these records gives you some idea of the time and labor which is involved. We did not appreciate it when we started. There were over fifty indicator cards taken on the engines, and the same number of tests on the generators.

The PRESIDENT. It would be instructive and interesting to have some discussion upon this matter, the development of the electric drive is now becoming so pronounced.

Mr. GEORGE I. ROCKWOOD. I would like to ask Mr. PAINE how the output was calculated. I presume from the curve and efficiency of the motor?

Mr. SIDNEY B. PAINE. The output of the motor can, of course, only be calculated from its input by means of the efficiency curves of the motor. This efficiency varies with the amount of power which the motor is delivering. It is necessary to bear this fact clearly in mind, especially in endeavoring to determine what are called "friction loads," otherwise the results obtained would be very misleading.

For instance, a friction load test was taken each half day during the week's run referred to in the paper under discussion. The maximum input to the motor was 34.9 h. p; the minimum 31.6 h. p.; and the average 33.11 h. p. As stated these readings include the losses in the motor. A 200 h. p. motor running on 17 or 18 per cent. of its rated capacity would be comparatively inefficient. This fact is not objectionable, inasmuch

as the motor is operated at or near its rated load when the machinery is in operation, and at that load it is very efficient.

Mr. RUSSELL W. EATON. If Mr. PAINE would permit me to go back to a paper he presented at a previous meeting, in which he showed that in same mill the power dropped off quite seriously the last half hour of the forenoon and afternoon; do later tests in that same mill show improvement in that respect?

Mr. SIDNEY B. PAINE. This curve drawing wattmeter has not yet been used on that mill. We have been making tests in a large number of other mills, and have been unable to get around to that particular mill; but we do find that same dropping off in every mill we have tested.

Mr. RUSSELL W. EATON. At that time I believe it was suggested by Mr. PAINE that the electric driving, with the power to test the driving, was a good thing.

I was wondering whether the mills having that recording wattmeter were able to keep the work better in the last half hour than the others?

Mr. J. R. MONTGOMERY. I would like to inquire of Mr. PAINE, if he could tell the loss of power between the generator and the motor, without regard to shafting or belting.

Mr. SIDNEY B. PAINE. Do you mean the loss through the wire itself?

M.r J. R. MONTGOMERY. From the generator to the motor.

Mr. SIDNEY B. PAINE. It is probably from 2 to 2½ per cent. probably not more than that.

The PRESIDENT. Will some other member interested in or acquainted with the subject continue the discussion?

Mr. JOHN A. FERNLEY. If the generator should run four or

five revolutions per minute slower than usual would it make any difference in the electric power generated, and thereby lose power or speed?

Mr. SIDNEY B. PAINE. Yes; an induction motor would show the reduction in the speed on the engine. But an engine suitable for cotton mill driving ought not to show any such variation.

Electrical Measurement of Power Required in Manufacturing Heavy Cotton Goods, LOUIS I. GUION. Paper read by Secretary.

ELECTRICAL MEASUREMENT OF POWER REQUIRED IN MANUFACTURING HEAVY COTTON GOODS.

Louis I. Guion, Columbia, S. C.

The Columbia Mills Co., of Columbia, S. C., of which the following details are given, is a plant of 23,244 spindles, and is complete for the manufacture of various classes of duck, from raw material to finished goods, and the figures given in this paper are based on the mill spinning yarns, averaging No. 9½ to 10, and twisting from No. 7 yarn—24 ply, to No. 20 yarn —2 ply.

Operation of Motors.

A portion of the motors, (those whose speed is 540 revolutions per minute) receive current from a power plant owned by the mills. This plant consists of four (two pairs) 48 inch horizontal turbine wheels of the Stilwell–Bierce & Smith–Vaile make. Each pair of wheels will develop 1000 horse power under 26.8 foot head, with two direct-connected General Electric generators, with revolving armatures.

The generators each have a normal rating of 500 kilo-watts, and are 36 cycle, 570 volts. The balance of the motors in mill receive current from another water power plant, not owned by the mills, that also furnishes current for other manufacturing interests of Columbia and vicinity.

The current received from the latter source has a periodicity of 40 cycles and is generated at a voltage of 3,240 which is

transformed to 550 volts at the basement of the Columbia Co.'s mill, whence it is distributed to the various motors.

It is very interesting to note that this plant was the first cotton mill in the world to be completely equipped with electric drive, and it has no auxilliary power, except one 50 horse power engine, to drive a fan for heating system when the power house is closed down on nights and Sundays.

* At this point a little history may not be amiss. In the early part of the nineteenth century, the people of South Carolina, feeling the necessity for better facilities for transportation, took part in the wide spread interest at that time, in "internal improvements", as the development of good roads and canals was termed, and they spent several million dollars in canals around the shoals in the water courses within her boundaries.

Between 1817 and 1826, the State of South Carolina appropriated and expended about $300,000. in constructing the Columbia canal around the falls of the Congaree and Broad rivers, to facilitate transportation between the up-country and the cities on the sea coast. This canal was five miles long, 16 feet wide at the bottom and 28 feet wide at surface of water, and answered the purpose of one of the highways of commerce by uniting the navigable waters of the Congaree, Broad and Saluda rivers. For many years, 130,000 to 150,000 bales of cotton were transported each season to Columbia through this canal. However, the construction of the railroad in 1842, connecting Columbia and Charleston, destroyed the usefulness of this canal as a highway of commerce.

In 1868, during the dark days through which South Carolina passed after the Civil war, the State transferred the canal to the late Governor WILLIAM SPRAGUE of Rhode Island, (at that time the leading cotton manufacturer of this country), who expended $100,000. in its improvement, endeavoring to change it from a canal for navigation to one for the development of power. Governor SPRAGUE became financially embarrassed, and in 1873 transferred the canal back to the State.

*Taken from an article on Columbia, by J. W. Babeack, LL. D.

Between 1873 and 1886 the State spent $250,000. in enlarging the canal, and in 1887 the General Assembly placed it in the hands of a Board of Trustees and authorized the City of Columbia to guarantee and to pay the coupons on bonds to be issued by the Trustees.

In 1888 the Trustees began active operations for the improvement of the canal below the locks on Broad river to Gervais street, a distance of about three miles. This work was completed in 1891, having cost the city of Columbia $262,000.

Thus in 1891 the improvements in the Columbia canal were completed to the foot of Gervais street, having cost the State, Gov. SPRAGUE, and the City of Columbia, $912,000. From the head of the canal to Gervais street, there was not a single site available for building mills that could be directly driven by water power. Not a great while after the completion of the canal it passed out of the hands of the Trustees, being transferred to the Columbia Water Power Co. The Columbia Mills Co., having been projected to be driven by power from the canal, it was either necessary to extend the canal below Gervais street, at the cost of thousands of dollars, in order to secure a desirable site for a direct driven mill, or to install electric driving, or to accept one of the plans given below.

The General Electric Co. were at this time making great claims for the electric drive, and here was a case of great necessity. If electricity could be used, there were numerous sites along the east bank of the canal between the locks and the Gervais street end that could be utilized for mills.

One plan contemplated the installation of a rope drive from the power house to mill, a distance of over 700 feet; another plan suggested was to tunnel under canal from the mill, back into the tail race 700 feet; and another plan was to change the course of the canal running it around the city side of the mill, utilizing a small stream and natural water course for a wasteway. Either of these plans were costly and practically prohibitive. It was, however, decided by the projectors of the mill, to build it on its present site and accept the risk of incorporating the electric drive.

For about ten years this plant has been running continuously with and by the electric drive, and with considerable overtime; and as tests given hereafter will show, many motors have been running much over their normal rating during this time, and so far as can be ascertained, the motors, with few exceptions, are as good as the day they were started, and have never given the slightest trouble.

The total frictional load, based on the maximum load with all machinery running under conditions that existed when the tests were made, is 22.4 per cent.; this includes the loss of power consumed by motor. This frictional load could be greatly reduced were counter pulleys with wider faces substituted in many cases (particularly in carding and spinning departments) for the narrow pulleys now in use, so as to allow the use of wider belts, allowing these latter to run slacker than those now in service, which have to be kept excessively tight. At the time these pulleys were put into service, little was known as to the amount of power required by the various machines; had the amount of power estimated to run the machinery been correct, the width of belts now in use would have been ample. The fact that various motors are overloaded, as shown by tests, shows that comparatively little was accurately known ten years ago as to the amount of power required to operate cotton mill machinery under these conditions. Further, a few of the motors originally installed were found to be overloaded so much as to require the installation of larger ones in their place.

At this point it might be well to call attention to the fact that the maximum load is never thrown on the entire mill at any one time; and seldom is the maximum load on any one motor at any time; still the motor is a unit, and is liable to have to carry its maximum load momentarily, and for some minutes, occasionally, and it is therefore necessary to have belts ample to transmit the maximum load without having them unduly tight. If this precaution is not taken, the belts will be a constant source of annoyance, either running off when load is thrown on, or, what is more serious, slipping constantly, causing irregular

speed, bad work, and low production. When belts must be kept unduly tight to prevent slipping, it is necessary to be constantly taking them up and rarely is the same tension obtained at these various times.

I therefore think I am conservative in saying, that when belts are used that are not of ample carrying capacity, there is no such thing as even speed. I believe that any machinery used in the manufacture of cotton will produce more goods and of a better quality at a speed far below the average, than at a speed which is uneven and irregular.

In spinning, one can use high speeds and get quality and quantity and have work run sufficiently well to keep the help satisfied. At low speeds one can keep things going and perhaps not do much less than when running high speed, but to be obliged to operate a mill where the range of speeds on any machine, or class of machines, is of considerable variance is a matter of serious consequence. For instance, in a weave room, looms can be easily run at 160 picks per minute and can, by adjustment, be run at 120, but it is impossible to operate the looms satisfactorily when the speed changes to this extent during the running hours of the mill, and get either the quality or quantity to make the mill a success.

Where the prime mover is regular, I do not believe that any other mode of driving can equal the regularity of speed as produced by the use of the electric drive.

There are many advantages to be claimed for the electric drive, but these have been fully set forth by able men, and I shall dwell but briefly upon these points. This paper is designed to present facts as to power required to operate cotton mill machinery, manufacturing heavy cotton goods.

At the Seventy-seventh meeting of this Association, at Bretton Woods, a paper was presented entitled, "Electric Measurement of Power Required in Cotton Manufacture." In the closing paragraph of that paper, the invitation is given to compare consumption of power in plants operated under different conditions, with or without the electric drive. I am, therefore, for the sake

of comparison, following the methods as nearly as is practical, pursued in that paper, that comparison may be drawn by those who are interested enough to take the trouble.

Before we take up the subject of which this paper treats most particularly, let us for a few moments consider some of the advantages the electric drive sets forth.

If the mill is so fortunate as to have water power, the advantages are many. The power house can be, in most cases, more conveniently arranged if the engineer does not have to consider the location of the mill; the power house is small and compact and can be easily located and substantially constructed, even in the middle of the river. In several cases which have come under my observation, the power house could be built for the electric drive, for less than the cost of excavating a tail race, where the mill had to be driven direct from the shaft. In most localities, where mills are built beside water courses, it is necessary to construct heavy expensive walls to protect them from floods. If the electric drive is used, the mill can be set on a higher elevation, or near side track or railroad, thus doing away with expensive sidings.

Again there is one point I would lay particular stress upon, and that is in a steam driven mill the power house must be located upon a water course sufficient for boiler, feed water, and condensing purposes.

Now in considering the electric drive in the mill, we avoid belt towers, with the consequent dark corners and loss of floor space; we have no massive head-shafts; we have no large belts to care for. Then again, any one department can be stopped or operated independent of the other departments, and there are few mills so evenly balanced that it is not desirable and economical to close up some department for a few hours occasionally, or else to run some department or process a few hours overtime.

Further, we have a minimum of shafting to care for, and by having a recording watt-meter, and giving your shafting a five or ten minutes' test once a month, you can always tell whether

it is properly aligned, levelled and oiled, a thing often impossible to do in a direct driven mill.

On January 10th, 1905, in testing a motor, we found that the shafting on motor No. 15, (hereinafter described,) was taking up 55 per cent. of the power put into the motor; after working two hours for three nights on this shafting, we reduced the friction load to 22.3 per cent., with a resultant saving of 21.25 horse power. This is very interesting as showing the amount of power which may be lost by poor alignment of shafting or too tight belts, even on a small section such as was driven by this motor. Had this shaft been driven by the ordinary mechanical method, we could not have located the trouble, and perhaps it would have run six months before being corrected.

TABLE NO. 1.—SCHEDULE OF MOTORS.

Mill Motor Number.	Type.	Cycle.	Horse Power.	Volts.	Belted.	Revolutions Per Minute.	Belted 1 or 2 Ends.	
1	I	40	100	550	Belt.	540	2	Beaming, Openers, Scrapers, Etc.
3	TI	36	65	550	"	540	2	Weaving, 74 looms.
4	"	36	65	550	"	600	2	" 94 "
5	"	36	65	550	"	600	2	" 81 "
6	"	36	50	550	"	600	2	" 112 "
								" 98 "
7	"	36	65	550	"	540	2	Bobbin and Cone Winding.
8	"	36	65	550	"	540	2	Roving 4224 Spindles.
9	"	36	65	550	"	540	2	Cards, R. W. & D. F. Slubbers.
10	I	40	150	550	"	540	2	" " " "
11	TI	36	65	550	Direct.	540	—	Pickers (12)
12	"	36	65	550	"	540	—	" (12)
13	I	40	150	550	Belt.	600	2	Spinning 6792 and Spooling.
14	TI	36	65	550	"	540	2	" 3348 "
15	"	36	65	550	"	540	2	" 2352 and Spoolers,
16	"	36	65	550	"	540	2	" 2688 and Spooling.
17	"	36	65	550	"	600	2	" 2688 "
18	"	36	65	550	"	540	2	" 2688 "
19	"	36	65	550	"	540	2	" 2688 "
20	"	36	65	550	"	540	2	Twisters and Cone Winders, Slashing.
21	"	36	65	550	"	600	2	"
22	I	40	100	550	"	600	2	" " "

Table No. 1 gives a schedule of motors operating the different departments. This table gives the numbers of the motors as they are numbered and known in the mill, and as they will be known in the tests and tables given hereinafter. It also shows

the type of motor, the periodicity of the current, rated capacity of motor, voltage, speed, whether belted or direct connected, and the details of the machinery operated by it.

TABLE NO. 2.—MOTOR H. P. FULL LOAD AND NO LOAD.

Mill Motor Number.	Size Motor in H. P.	H. P. in Full Load.	H. P. No Load.	Per Cent. Machinery on Full Load.	Estimated H. P. For Machinery Idle.
1	100	102.41	33.33	96.	2.76
3	65	65.	23.40	50.	20.80
4	65	65.	23.40	50.	20.80
5	65	61.1	26.	50.	17.55
6	50	52.	29.20	73.2	6.11
7	65	49.21	18.62	40.	18.35
8	65	90.44	22.61	77.	15.60
9	65	62.51	12.63	85.	7.48
10	150	160.	29.26	90.	13.07
11	65	98.42	14.63	100.	
12	65	75.81	15.30	88.	7.26
13	150	196.80	19.95	100.	
14	65	57.19	15.29	100.	
15	65	51.87	13.33	100.	
16	65	83.77	13.33	100.	
17	65	57.30	15.96	100.	
18	65	62.51	18.62	100.	
19	65	59.85	15.96	100.	
20	65	90.44	23.94	100.	
21	65	77.14	15.96	100.	
22	100	130.	21.28	100.	
	1590	1748.77	422.00		129.78
		129.78			
		1878.55			

24.1 per cent. friction load at 1748.77
22.4 " " " " 1878.55

This table gives the mill number of the motor; the size of motor (i. e., its normal rating); the horse power that was being actually developed, under full machinery load, and the horse power at no machinery load, or the friction load of the shafting.

In the foregoing tests, the power given as required to operate the shafting and motors, was taken when motors were running at their lowest efficiency, and consequently the amount of power required to turn the shafting at speed, without machinery load, is much less than the figures given. The inability to obtain the efficiency curves of the motors in question has rendered it impossible to give the actual power to be charged to

shafting except as has been given which includes all losses in and through the motor.

The percentage of machinery on at full load, given in this table, was obtained by counting every two minutes, the number of machines of various kinds that were stopped during the time the tests were made.

The estimated horse power in the last column to be added, is based on the assumption that the machinery stopped, would have required the same amount of power per machine as those running during the test.

Referring to the footing of the columns in Table No. 2, we see the total nominal rating of the twenty-one motors was 1590 horse power, while the full load shows 1748.77 horse power with 129.78 horse power to be added for estimated horse power of machinery idle. This would give 1878.55 horse power as being required to drive the mill, if all the machinery was operated at one time. It is therefore evident that to drive all the machinery operated by these motors simultaneously it requires 288.55 horse power, or 15.3 per cent. more than the normal rating of the motors. This condition, however, never arises in any mill, especially in one having as coarse work as the mill whose operations we are now considering.

This may be more readily seen, when we consider that 7s yarn, run on 2 inch ring, 6 inch traverse, doffs every one hour and thirty-five minutes; 7s yarn with 2⅛ inch ring and 7 inch traverse doffs every one hour and forty-eight minutes; and 12s yarn on 2 inch ring and 6 inch traverse doffs every two hours and forty-seven minutes; also on twisters 7/5 filling on 4 inch ring, doffs every forty minutes; 7/7 filling on 4 inch ring, 6½ inch traverse, doffs every thirty minutes; 7/4 warp on 4 inch ring, doffs every one hour and forty minutes. On slubbers, .29 hank roving, doffs every twenty minutes; on .50 hank roving intermediate roving frame, doffs every thirty-five minutes; on .95 hank intermediate roving frame, doffs every one hour and seventeen minutes, and in weaving, often the filling will not last for a minute.

On account of this frequent doffing in carding, spinning and twisting, and the frequent changes of shuttles in weaving, it may be readily seen we can never get the *full* machinery load on at any one time.

During the tests recorded in Table No. 2, effort was made to operate all belts possible on the tight pulleys of the machines.

During the year 1903, the average power consumed by these various motors was 1516 horse power, and during 1904, 1531 horse power, measured at the switch boards by registering watt meters. What the line loss is from switch board to motors I do not know exactly, but it is between three and four per cent., the distance from motor to switch board being from 700 to 1000 feet.

The tests shown in Table No. 2 were made between Dec. 5th and Dec. 10th, 1904. The average temperature of different departments during these tests, was as follows:

Room.	Outside.	Inside.
Picker and opener room,	52.5	69.5
Carding department,	51.3	78.2
Spinning "	55.5	85.
Twisting "	50.4	69.1
Weaving "	52.6	72.4
Cloth and beaming,	52.5	69.5

TABLE NO. 3.—WEIGHT OF SHAFTING, PULLEYS, ETC.

Mill Motor No.	NUMBER BEARINGS.								WEIGHT.			
	1 1/16	2 1/16	2 7/16	2 11/16	2 15/16	3 1/16	3 7/16	3 11/16	Total.	Shafting.	Pulleys.	Total.
1	4	28	27	13	15	3	13	2	195	14762	14178	28940
3			8	6	35		12		61	11207	10225	21432
4				10	47		16		73	14473	14103	28575
5					55		4		59	12981	7545	20526
6			52		26				78	8816	5835	14651
7			31	26	9				66	12876	8290	21166
8		4	2	30					36	4132	5227	9359
9			20	16	9	6			51	9024	5389	14413
10			36	31	7	9			83	12789	7014	19803
11					7				7	1702	1454	3156
12					9				9	1564	1454	3018
13			12	36	2	8			58	8013	8698	16711
14				6	6	8			20	2607	4103	6710
15				8	2	8			18	2354	3620	5974
16				20		2			22	3540	3512	7052
17				20		2			22	3460	3430	6890
18				10	2	8			20	2541	3757	6298
19				8	4	8			20	2574	4024	6598
20	22		2	16	10		2		52	5525	5102	10627
21					5			3	8	1970	1586	3556
22	12	2	2	20	21		2		59	8500	5695	14195
	38	34	192	276	271	62	49	5	927	124907	144743	269650
										5.37 Lbs. per Spl.	6.23 Lbs. per Spl.	11.6 Lbs. per Spl.

.039 bearings per spindle.

This table, No. 3, gives the size and number of bearings, the weight of shafting and pulleys, and the total number of bearings and total weight of shafting and pulleys.

From this table we find that there is 11.6 pounds of rotating material per spindle, or 3.43 times as much rotating material and four times the number of hangers per spindle as in the Olympia mill, details of which were given at the last meeting of the Association. Yet the friction load given was 21.81 per cent. as the results of trials at that mill, while for the Columbia Co., in spite of the greater weight of shafting, etc., the friction load is only 22.4 per cent. or six tenths of one per cent. more than the Olympia. I attribute this condition to the fact that our motors are running at full load, and therefore at high efficiency, while the Olympia motors were running far below

their normal rating, and therefore at a low efficiency, with but few exceptions. This clearly shows the necessity of using a motor of proper size to drive a given amount of machinery.

TABLE NO. 4.—DISTRIBUTION OF POWER.

Department.	Total Horse Power.	Percentage.
Carding,	523.78	29.95
Spinning,	569.29	32.55
Twisting,	318.89	18.24
Weaving,	271.	15.49
Cloth,	15.	.86
Beaming,	50.81	2.91
Total,	1748.77	100.00

This shows the distribution of power among various departments, showing percentage required in each.

TABLE NO. 5.

Motor Number.	No. Yarn.	Spindle Speed.	Net Spindles per H. P.	Gross Spindles per H. P.	Ring.
17	12	8387	43.7	33.3	2
15	12	8010	47.1	35.3	2
17	12	7466	55.2	44.1	2
15	12	7511	54.4	41.6	2
17	12	6764	58.9	43.6	2
15	12	6764	58.9	41.7	2
17	7	8116	38.8	31.3	2
17	7	7476	47.7	30.4	2
17	7	6764	50.	31.	2
13	7	6920	43.1	35.3	2⅛

Table No. 5 gives the spindles per horse power as driven by motors Nos. 13, 15 and 17, for different numbers of yarns at various speeds and on 2 inch ring, 6 inch traverse, and 2⅛ inch ring, 7 inch traverse. It is interesting to note that by increasing the speed 10½ per cent. from 6764 revolutions per minute, we loose 6.2 per cent. in number of spindles run, per horse power. By increasing speed 24 per cent. we decrease the number of

spindles per horse power, 25.8 per cent. It is also interesting to note that number 7s yarn on 2 inch ring, 6 inch traverse, takes one horse power to 50 spindles, whereas the same yarn on 2⅛ inch ring, 7 inch traverse, requires one horse power to 43.1 spindles, a difference of 2.3 per cent. in speed, and 13.8 per cent. in number of spindles run, per horse power, showing the larger ring requires more power.

By reference further to Table No. 5, you will notice that at the same spindle speed on numbers 7s and 12s yarn the spindles ran about 47.7 per horse power on the former, and about 55.2 per horse power on the latter, or about 7½ spindles more per horse power on the finer number of yarn.

TABLE NO. 6.

Motor No.	Size Ring.	Spindle Speed.	Spindle per H. P.
	2 and 3½ inches.	4544	72.
21	3½ inches	3452	43.3
	4 "	2147	38.7

Table No. 6 gives speed of spindles, size ring, and spindles per horse power on twisters, 6½ inch traverse.

The following are illustrations of charts, which are facsimiles of those taken during the tests, the results of which are given in the previous tables; and so far as is practical, the machinery driven by each motor is given sufficiently in detail, it is hoped, to be intelligible to all.

Charts Nos. 1 and 2, are tests on picking machinery.
Chart No. 3 is for roving machinery.
" 4 for cards and drawing.
" 5 for spinning.
" 6 for twisters.
Charts Nos. 7 and 8 for weaving.

The results obtained on these tests, as shown by the charts, illustrate the inaccuracy inevitable with the differential method. Such a plan assumes that each of the machines, similar in design and on the same class of work, consumed the same amount of

power. Everyone familiar with machinery is fully aware that this is not the case. For instance, no two spinning frames are in the same physical condition. No two frames are banded under the same tension. This differential method, however, is the usual method employed, and has therefore been followed in these tests, and also to demonstrate its inaccuracy. At the same time, we frankly admit that we know of no method which will insure absolute or even approximate accuracy.

SCHEDULE OF MACHINERY,—Columbia Duck Mills, January, 1905

PICKING DEPARTMENT.

8 Self feeders and openers, built by Kitson, on No. 1 motor.

8–40 inch breakers, built by Kitson; 4 on No. 11, 4 on No. 12 motor Speed beaters, motor No. 11, 1400 R. P. M.; motor No. 12, 1456 R. P. M.

8–40 inch intermediate pickers, built by Kitson; 4 on No. 11, 4 on 12 motor. Speed beaters, on No. 11, 1420 revs.; on No. 12, 1433 revs.

8–40 inch finisher pickers, built by Kitson; 4 on No. 11; 4 on No. 12. Speed beaters, on No. 11, 1409; on No. 12, 1405 revs.

2 thread extractors, built by Kitson.

CARDING DEPARTMENT.

104–40 inch R. T. cards, built by Dobson & Barlow.

2–40 inch " " " Saco & Pettee Machine Shops.

2–40 inch " " " Whitin Machine Co.

35 cards on motor No. 9; 73 on motor No. 10. Speed card cylinders, 165 R. P. M. Weight lap, per yard, 16 oz. Weight sliver, per yard, 72 grains.

60 railway head deliveries, built by Whitin Machine Co.

20 on motor No. 9; 40 on motor No. 10. Speed, front roll, 550 R. P. M. Number of doublings, 8; draft, 5.38. Weight sliver, per yard, 107 grains.

14 drawing frames, 2 heads each of 4 deliveries each,—112 deliveries. Built by Dobson & Barlow. 40 dels. on motor No. 9; 72 dels. on motor No. 10. Speed, front roll, 350 R. P. M. Number of doublings, 6; draft, 5.49. Weight sliver, per yard, 117 grains.

10 slubbers, 72 spindles each, 12x6 inches. Built by Dobson & Bar-

low. 3 frames on No. 9 motor; 7, on No. 10 motor. Speed, driving pulley, 322 R. P. M.; fliers, 552 R. P. M. Number of roving, .29 hank; twist, .65 per inch.

16 intermediate frames, 108 spindles, 10x5 inches. Built by Dobson & Barlow. On motor No. 8. Number roving, .45 and .90 hank. Speed, driving pulley, 472 R. P. M.; fliers, 780 and 902 R. P. M.

16 fine frames, 156 spindles, 8x4 inches. Built by Dobson & Barlow. On motor No. 8. Number roving, 1.50 and 2.00 hank. Speed, driving pulley, 400; fliers, 1046 R. P. M.

Spinning Department.

91 frames, 168 spindles, 3x2x6 inches,	15,288	spindles
39 " 204 " 3x2⅛x7 inches,	7,956	"
Built by Saco & Pette.	23,244	"

The 168 spindle frames are located as follows: 5 on motor No. 13; 8 on No. 14; 14 on No. 15; 18 on No. 16; 16 on No. 17; 16 on No. 18; 14 on No. 19.

The 204 spindle frames are: 31 on motor No. 13; 8 on No. 14.

Speeds, cylinder, on 7s, 972; 12s, 1055; 13s, 1055.

" spindles, on 7s, 6788; 12s. 7585; 13s, 7585.

No. 4 Draper spindle; 7 inch drum; ⅞ inch whirl.

Spooling.

6 spoolers, 108 spindles, 8x4 inches. Built by Draper. On No. 13.

12 " 88 " " " " " 4 each on No. 15, No. 18 and No. 19.

4 spoolers, 98 spindles, 8x4 inches. Built by Draper. On No. 14. Speed, cylinder, 335; spindle, 860.

Twisting Department.

12 twisters, 144x5x4x7 inches,	1728	spindles.
30 " 144x5x3½x7 inches,	4320	"
2 " 240x3x2x7 inches,	480	"
Built by Draper.	6528	"

Diameter, drum, 8 inch; whirl, 1⅛, 1¼ and 2½ inches.

Frames on motors as follows: 4 inch ring, 10 frames on No. 21; 2 on No. 22. 3½ ring, 10 frames on No. 20; 8 on No. 21; 13 on No. 22. 2 inch ring, 2 frames on No. 21.

12 Brownell twisters, 24 spindles each — 288 spindles. 4 on No. 22; 8 on No. 20.

4 Brownell twisters, 60 spindles each — 240 spindles. On No. 22.

Speed spindles, 24 spindle frames, 1145 R. P. M.
60 " " 1250 "

Cone Winders.

7 frames, 42 spindles, built by Foster, 115 to 140 R. P. M.
2 " 44 " " " " 260 R. P. M.
1 " 52 " " " " 260 "
1 " 66 " " " " 260 "

7 of 42 spindles for 10 inch cones have 12x7¾ drums; 4 on No. 30; 3 on No. 22.

1 of 44 spindles for 3 inch cones have 9x6 drums; on No. 7.
1 " 52 " " 9 " " " 11x6 " on No. 7.
1 " 66 " " 6 " " " 6x6 " on No. 22.
1 " 44 " " 6 " tubes " 7x6 " on No. 7.

Bobbin Winders.

11 frames, 80 spindles each, 510 and 615 R. P. M. Built by Lever & Grundy. 8 frames on motor No. 7; 3 on No. 22.

1 quiller, 72 spindles, 710 R. P. M. On No. 22. Built by Lever & Grundy.

4 Draper warpers, 54 inches between beam heads, with creels for 8x4 spools. On motor No. 7.

2 Cohoes slashers, 7x5 foot cylinders; creels for 12 beams. On motor No. 20.

3 rope machines, built by W. C. Boone. On motor No. 22. One with 4 spindles, 140 R. P. M.; 2 with 2 spindles each, 140 R. P. M.

Weaving Department.

32	52 inches	7	25	—
110	64	48	32	30
20	64½	—	—	20
32	76	4	12	16
32	88	6	17	9
2	100	—	2	—
10	106	2	2	6

4	118	2	2	—		
7	134	5	2	—		
249						
12	26	—	—	—	6	6
22	36	—	—	—	3	19
35	37	—	—	—	33	2
50	44	—	—	—	12	38
91	46	—	—	—	58	33
210		74	94	81	112	98

Total, 459. All Crompton & Knowles.

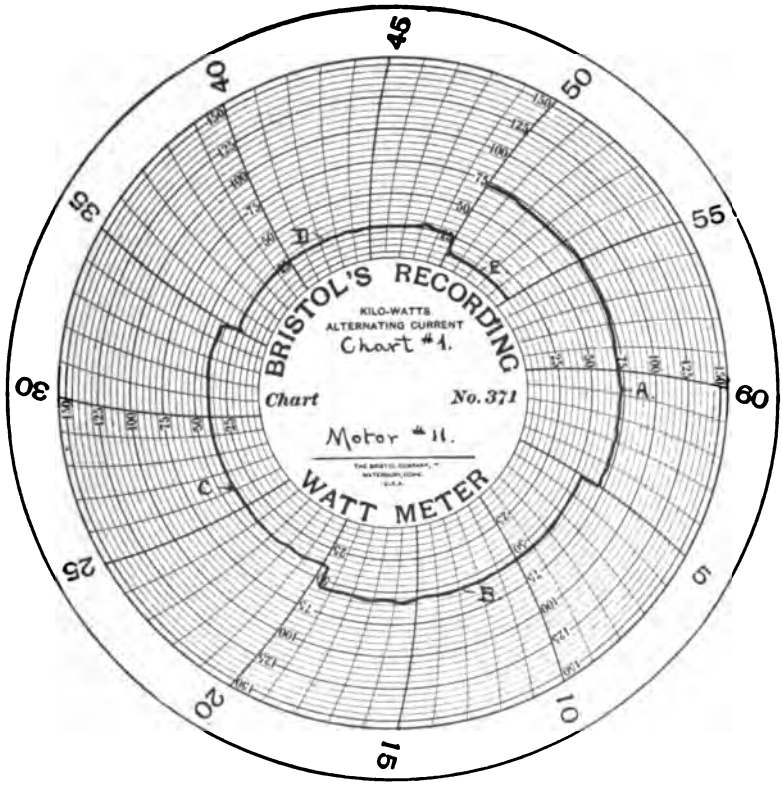


CHART NO. 1.

Motor No. 11, 65 horse power, operating four breaker, four intermediate, and four finisher pickers, working about 50 per cent. waste, such as card, drawing and alley waste and strippings. All pickers were making 40 inch, 16 ounce laps. Speed of beaters on breakers was 1400 revolutions per minute, intermediates 1420, and finishers 1409. Test made Dec. 5th, 1904, from 1.55 to 2.55 P. M. Outside temperature, 55.4; inside temperature, 78.

TABLE NO. 1.

Load.	Breakers.	Inter.	Fin.	Total.	Total H. P.		H. P. per Machine.
Full	4	4	4	12	98.6	=	8.21
75 per cent.	3	3	3	9	75.81	=	8.42
50 "	2	2	2	6	50.54	=	8.42
25 "	1	1	1	3	33.30	=	11.1
	0	0	0	0	14.63		

Friction load = 14.8 per cent.

TABLE NO. 2.

A	12	machines	98.6	H. P.	—	14.63	= 83.97	H. P. net	= 6.99	H. P.	each
B	9	"	75.81	"	—	"	= 61.18	" "	= 6.79	"	"
C	6	"	50.54	"	—	"	= 35.91	" "	= 5.98	"	"
D	3	"	33.30	"	—	"	= 18.67	" "	= 6.22	"	"

TABLE NO. 3.

A	3	machines	98.6	H. P.	—	75.81	= 22.79	H. P. net	= 7.59	H. P.	each
B	3	"	75.81	"	—	50.54	= 25.27	" "	= 8.41	"	"
C	3	"	50.54	"	—	33.30	= 17.24	" "	= 5.74	"	"
D	3	"	33.30	"	—	14.63	= 18.67	" "	= 6.22	"	"

Table No. 1 gives gross horse power required per machine, which includes load of motor and shafting, and different degrees of load from full load to no load, and the percentage of friction of motor and shafting.

Table No. 2 gives the net horse power per machine, and is obtained by deducting the friction load of shafting from the horse power required to drive the machinery in each division of test, as shown on Chart No. 1. Owing to the fact that friction

load of shafting may not remain the same during the test, from no load to full load, and further, that it is certain that the efficiency of a motor is not always the same, I have tabulated the net power required in a different way, as is shown in Table No. 3.

This is done by deducting the horse power required in each succeeding part of the test, from the horse power consumed in the portion of test that has just gone before. This method will be used, as well as the method used in Table No. 2, whenever practicable, in all tests hereafter shown. Motor drives 74 feet $2\frac{15}{16}$ inch shafting, running in seven bearings. Total weight of pulleys and shafting is 3156 pounds.

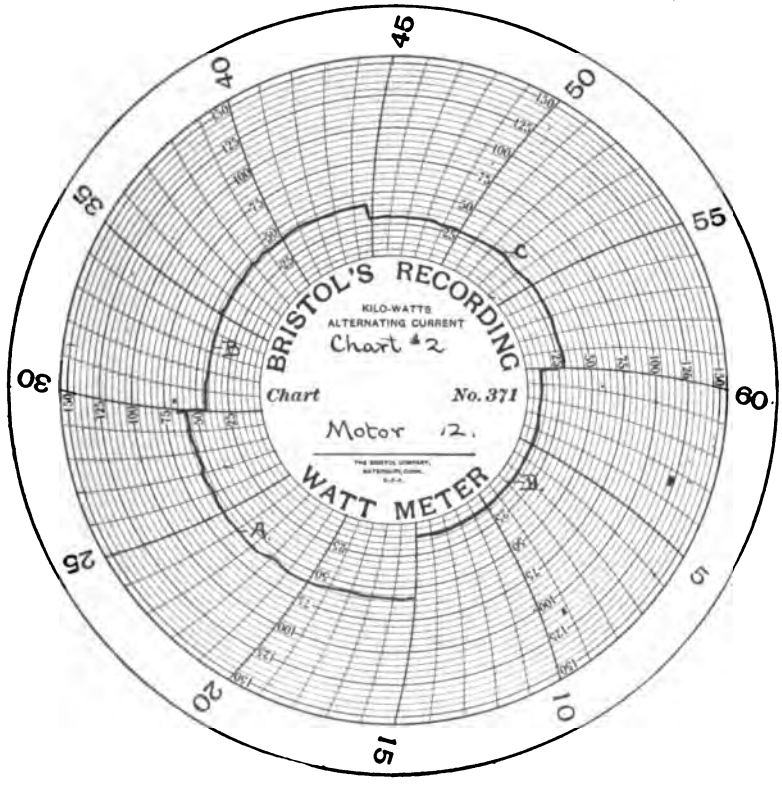


CHART NO. 2.

Motor No. 12, 65 horse power, direct connected. This test was made Dec. 15th, 1904, from 3.15 to 4.15 P. M. Temperature outside, 54; inside, 79.4. Total machinery operated: four breaker, three intermediate and four finisher pickers. Speed of beaters on breakers 1455, intermediates 1412, and finishers 1406 R. P. M.

TABLE NO. 1.

Breakers.	Intermediates.	Finishers.	Total.	Total H. P.	Horse Power per Machine.
4	3	4	11	75.81	6.90
4	3	0	7	54.53	7.80
4	0	0	4	39.90	9.97
0	0	0	0	15.30	

Friction load = 20.1 per cent.

TABLE NO. 2.

	Machines.	Gross H. P.		Less Shafting 15.30		Net H. P.		Net H. P. Per Machine.
A	11	75.81	—	15.30	=	60.51	=	5.50
B	7	54.53	—	15.30	=	39.23	=	5.32
C	4	39.90	—	15.30	=	24.60	=	6.15
D		15.30				15.30		

TABLE NO. 3.

A	4 machines	75.81	—	54.53	=	21.28	5.32	each net
B	3 "	54.53	—	39.90	=	14.63	4.87	" "
C	4 "	39.90	—	15.30	=	24.50	6.15	" "
D				15.30				

Tables 1, 2 and 3 correspond exactly to Tables 1, 2 and 3 on Chart No. 1. However, I would call attention to the fact that in Chart No. 1, one breaker, intermediate and finisher were taken at a time, while Chart No. 2 takes three breakers, three intermediates, and three finishers. It is interesting to compare Charts No. 1 and 2. Both motors, from which these charts were made, are 65 horse power, direct connected, and about the same amount of power is consumed in friction load. Motor No. 11, Chart No. 1, carries 14.63 horse power friction load,

and motor No. 12, Chart No. 2, carries 15.30 horse power friction load, a difference of only .67 of one horse power, and that is against the motor carrying the lighter load.

The machines on both motors are of exactly the same dimensions, making the same laps in both width and weight. The machines represented in Chart No. 1 were on about 50 per cent. white waste such as roving, alley waste from cards and drawing, and waste from scavenger rolls in spinning room; while machines represented in Chart No. 2 were on cotton without waste.

Motor No. 12 drives 68 feet of $2\frac{1}{16}$ inch shafting, running in nine bearings. Total weight of shafting and pulleys is 3018 pounds.

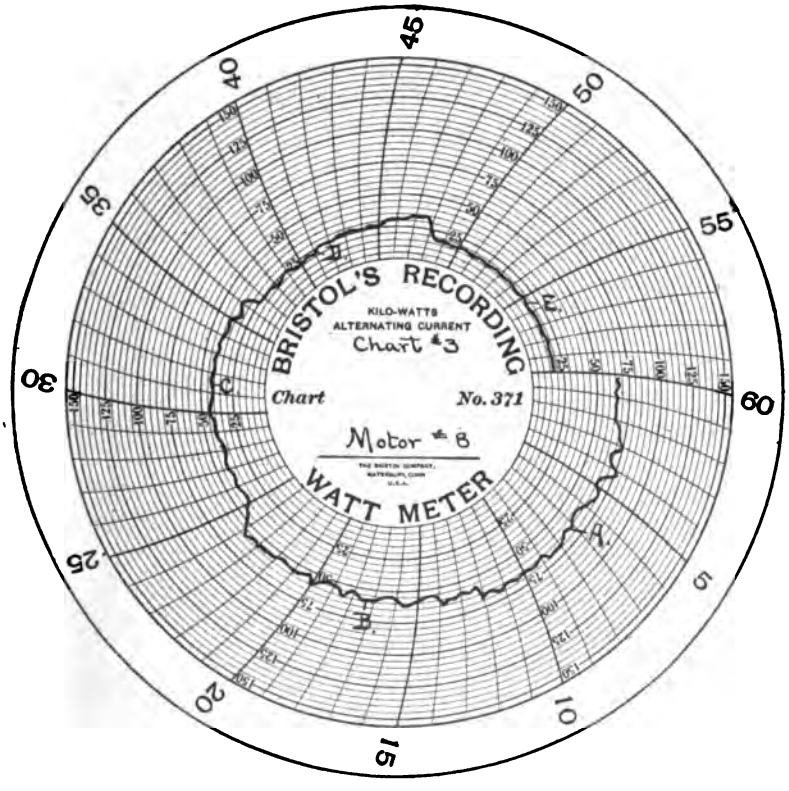


CHART NO. 3.

Motor No. 8 is belted from both ends. There are sixteen counter shafts in one bay. This test was made on Dec. 6th, 1904, from 11 A. M. to 12 noon; temperature outside 48.2, inside 78.2. This motor operates sixteen intermediate frames, 108 spindles each, and sixteen speeders, 166 spindles each.

TABLE NO. 1.

	Intermediate Spindles.	Speeder Spindles.	Total Spindles.	Total H. P.		Spindles per H. P.
A	1404	1685	3089	88.4	=	36
B	1480	915	2395	75.4	=	31.8
C	1188		1188	52.4	=	22.6
D	626		626	32.5	=	19.2
E				22.		

Friction load = 24.9 per cent.

TABLE NO. 2.

A	88.4	—	22	H. P.	=	66.4	=	46.6	spindles	per H.P.
B	75.4	—	22	"	=	53.4	=	44.8	"	" "
C	52.4	—	22	"	=	30.4	=	39.6	"	" "
D	32.5	—	22	"	=	10.5	=	59.6	"	" "
E	22.0									

TABLE NO. 3.

A	88.4	—	75.4	=	13.0	694	Spls.	53.4	spindles	per H. P.
B	75.4	—	52.4	=	23.0	1207	"	52.5	"	" "
C	52.4	—	32.5	=	19.9	562	"	29.0	"	" "
D	32.5	—	22.	=	10.5	626	"	59.6	"	" "

As stated above, these thirty-two frames are driven from sixteen counter shafts, and in nearly all cases the counter belts are too small to carry the load comfortably.

The motor drives the following lengths of shafting: 22 feet of $2\frac{3}{16}$, 11 feet of $2\frac{7}{16}$, and 184 feet of $2\frac{11}{16}$; weight of shafting, 4132 pounds; weight of pulleys, 5227 pounds; total, 9359 pounds.

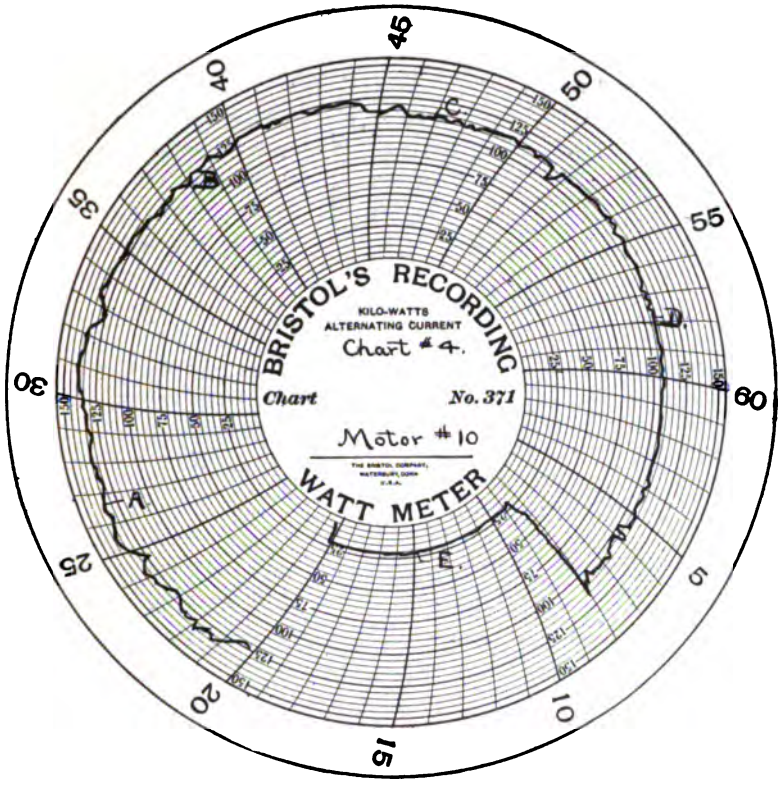


CHART NO. 4.

From motor No. 10, 150 horse power, belted. Test made Dec. 8th, 1904, 5.20 to 6.20 P. M. Temperature inside 83.8, outside 61.2. Motor operates seventy-three cards, fifty-four railway heads, seventy-two deliveries of drawing, and three hundred and sixty slubber spindles. Part of these machines were unavoidably stopped during the test.

TABLE NO. 1.

	Cards.	Draw'g.	Ry.	Slubber Spindles			
A	73	56	47	288	172	H. P.	— 29.2 = 143.7 H.P.
B	73	52	47		163.39	"	— 29.2 = 134.39 "
C	73	56			147.63	"	— 29.2 = 118.43 "
D	73				143.64	"	— 29.2 = 114.44 "
E					29.2	"	or 16.9 per cent. friction.

TABLE NO. 2.

A	172.9	— 163.59 =	9.31 =	30 slubber spindles per H. P.
B	163.59	— 147.63 =	15.96 =	3 railway heads " "
C	147.63	— 143.64 =	3.99 =	14 deliveries drawing.
D	143.64	— 29.2 =	114.44 =	1.56 H. P. card.
E	29.2			

The cards on this motor are 40 inch on wire, 50 inch cylinder, 24 inch doffer, 110 flats, carding about 300 pounds in eleven hours on 72 and 80 grain sliver. Cylinders turn 165 revolutions per minute; doffers, 18 revolutions per minute. All cards have 10 inch cans. Railway heads have 12 inch coilers, and the front roll runs about 550 revolutions per minute, producing 107 grain sliver. Drawing frames are arranged to bring speed of front roll to about 350 revolutions per minute, making 117 grain sliver. Slubbers are 12x6; spindles turn about 570 revolutions per minute on .29 hank roving.

This motor runs the following shafting: 355 feet of $2\frac{7}{16}$, 206 feet of $2\frac{11}{16}$, 56 feet of $2\frac{5}{16}$, and 63 feet of $\frac{3}{16}$; weight of shafting, 12,789 pounds; weight of pulleys, 7,014 pounds; total, 19,803 pounds; 83 bearings.

For motor No. 17, 65 horse power, drives from both ends. Test made Jan. 4th, 1905, 9.20 to 10.20 A. M.; temperature outside 30, inside 72. This motor drives fourteen spinning frames of 168 spindles each, 2 inch ring, 6 inch traverse. At the time this test was made, spindle speed was 8387 revolutions per minute.

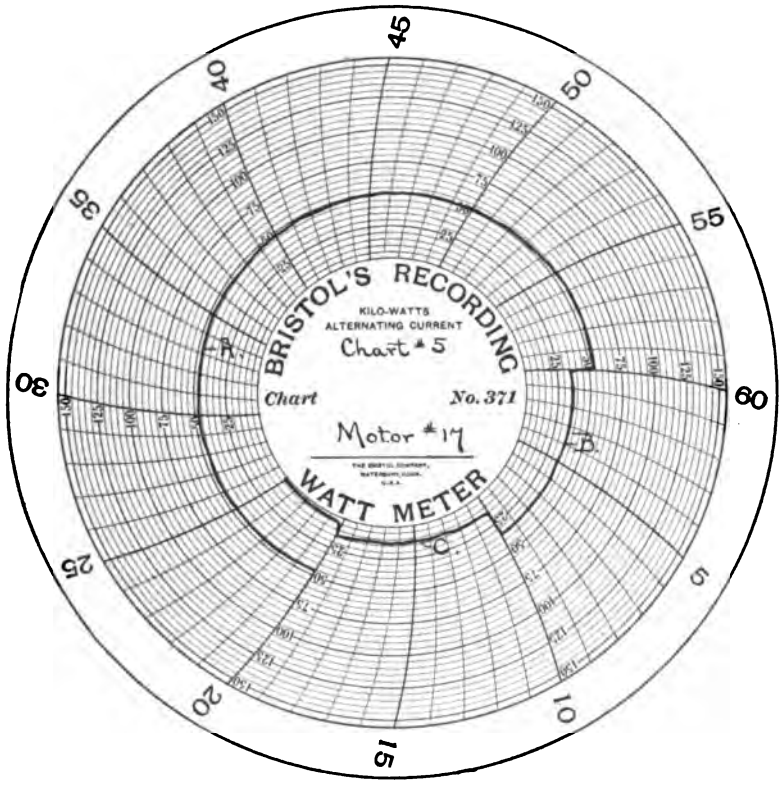


CHART NO. 5.

This is one of several tests made to find out as near as possible the power required to operate spindles at different speeds on different numbers of yarn, as shown on page 25.

This motor drives 146 feet of $2\frac{11}{16}$, and 20 feet of $3\frac{3}{16}$ shafting, with 3430 pounds of pulleys, 22 bearings, and 2342 spindles. Full load, 70.49; friction load, 16.62; net load, 53.77 horse power; gross spindles per horse power, 33.2; net spindles per horse power, 43.7.

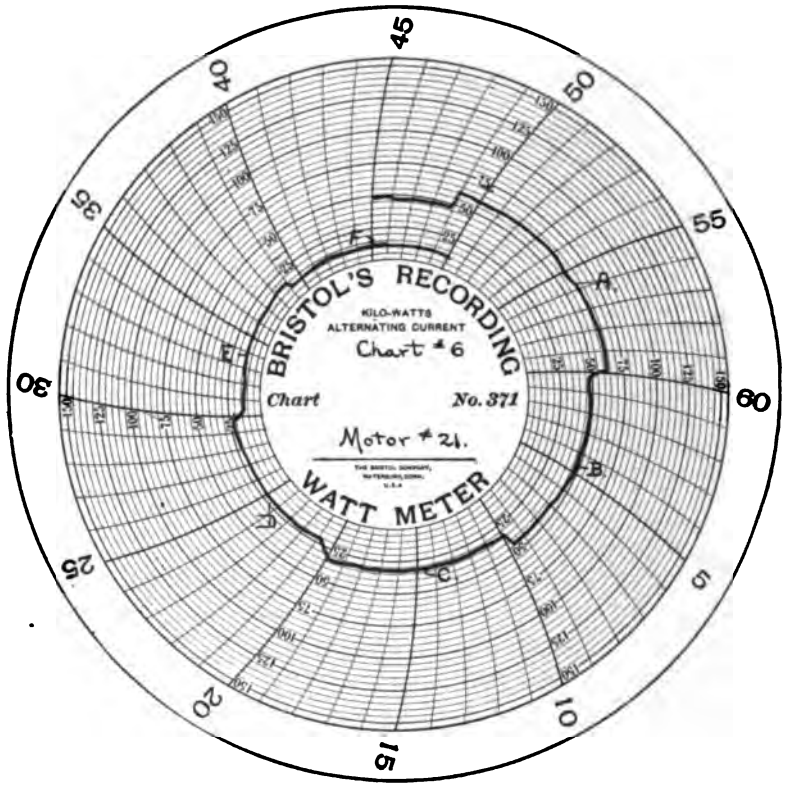


CHART NO. 6.

Motor No. 21, 65 horse power, belted both ends. Test made Dec. 8th, 1904, 9.50 to 10.50 A. M.; temperature outside 54, inside 72.

This motor drives:

8 Draper twisters, 144 splindles each; 1152 splindles 3½ ring, 6½ tr.
10 " " 144 " " 1440 " 4 " 6½ "
2 " " 240 " " 480 " 2 " 6½ "

3½ inch ring as follows: 1 on 10/2; 4, 7/3; 1, 13/2; 2, 12/3.

4 inch " " " 5½ on 7/5 warp; 1, 7/4 warp; 2, 7/5. figure; ½, 7/8 figure; 1, 7/4 figure.

2 inch ring as follows: 1 on 13/2; 1, 18/2.

TABLE NO. 1.

Number ½ inch Ring.	Spindles 4 inch Ring.	Spindles 2 inch Ring.	H. P.		Spindles per H. P.
1152	1440	480	77.14	=	40.
1152	720	480	62.51	=	37.6
1152		480	43.89	=	37.1
576		480	30.59	=	34.5
		480	19.95	=	24.0
			15.96		or 20.7 per cent. friction load.

TABLE NO. 2.

77.14	— 15.96	= 61.18	H. P.	÷	3072	spls.	= 50.2	spls.	per	H. P.
62.51	— 15.96	= 46.55	"	÷	2352	"	= 50.5	"	"	"
43.89	— 15.96	= 27.93	"	÷	1632	"	= 58.4	"	"	"
30.59	— 15.96	= 14.63	"	÷	1056	"	= 72.2	"	"	"
19.95	— 15.96	= 3.99	"	÷	480	"	= 120	"	"	"

TABLE NO. 3.

720 spls.	4 inch ring	77.14	— 62.51	= 14.63	H. P.	= 49.2	Spls.	per	H. P.
720 "	4 " "	62.51	— 43.89	= 18.62	"	= 39.0	"	"	"
576 "	3½ " "	43.89	— 30.59	= 13.30	"	= 43.3	"	"	"
576 "	3½ " "	30.59	— 19.95	= 10.64	"	= 54.1	"	"	"
480 "	2 " "	19.95		3.99	"	= 120.	"	"	"

This motor drives on to a shaft running at right angles to twisters, and all twisters are run two frames with one belt. With this arrangement we have only 50 feet of $2\frac{15}{16}$, and 20 feet of $3\frac{15}{16}$ inch shafting, weighing 1970 pounds, with eight hangers and 1586 pounds of pulleys.

From motor No. 3, 65 horse power, driving from both ends. Test made Dec. 9, 1904, 6 to 7 A. M.; temperature outside 42, inside 71.

This motor operates seventy-four looms of various widths and weights, divided as follows:

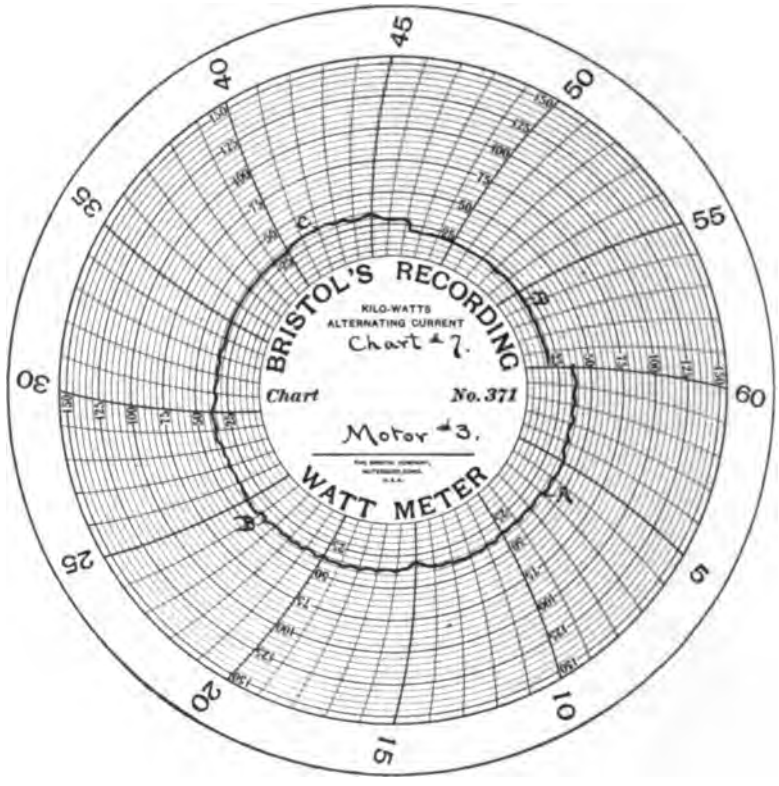


CHART NO. 7.

TABLE NO. 1.

Width.	No.	Heavy Pick.	No.	Medium Pick.	No.	Light Pick.	No.	Ex. Lt. Pick.	Tot. No.
52 inch	5	98	0		2	110			7
64 "	10	98	4	110	28	110	6	136	48
76 "			3	102	1	102			4
88 "	2	75	1	102	3	100			6
106 "	1	76			1	90			2
118 "	1	75	1	90					2
134 "	1	62	4	8					5
	20		13		35		6		74

These looms were operating on goods that weighed from pro rata 24 ounces to 22 inches down as low as 8 ounces to 40 inches, and the amount of power required per loom varies more with goods being woven than with widths. Of course wide looms on same weight goods require much more power than narrow looms on same goods.

TABLE NO. 2.

Looms Operated.	Horse Power.		H. P. per Loom.	
30	48.75	=	1.6	
24	46.8	=	1.3	
10	39.0	=	3.9	
	23.4			or 36 per cent. for friction.

TABLE NO. 3.

37 looms	65.	H. P.	—	23.4	=	41.6	=	1.1	H. P. per loom net	
30 "	48.75	"	—	23.4	=	25.35	=	.84	"	" "
24 "	46.8	"	—	23.4	=	24.0	=	.99	"	" "
10 "	39.0	"	—	23.4	=	15.6	=	1.56	"	" "

TABLE NO. 4.

65.0	—	48.75	=	16.25	H. P.	=	2.2	H. P. per loom.		
48.75	—	46.8	=	1.95	"	=	.3	"	"	"
46.8	—	39.0	=	7.8	"	=	.56	"	"	"
39.0	—	23.4	=	15.6	"	=	1.56	"	"	"

Little information of value further than an idea of the average power required per loom and extreme variations, can be gained from this table, as it was impossible to keep the stops of various widths and weights of looms and goods they are weaving. This motor drives ten feet of $2\frac{7}{16}$, forty-eight feet of $2\frac{1}{16}$, three hundred and five feet of $2\frac{5}{16}$, and ninety-six feet of $3\frac{7}{16}$ inch shafting. Total weight of shafting and pulleys, 21442 pounds; total number of bearings, six.

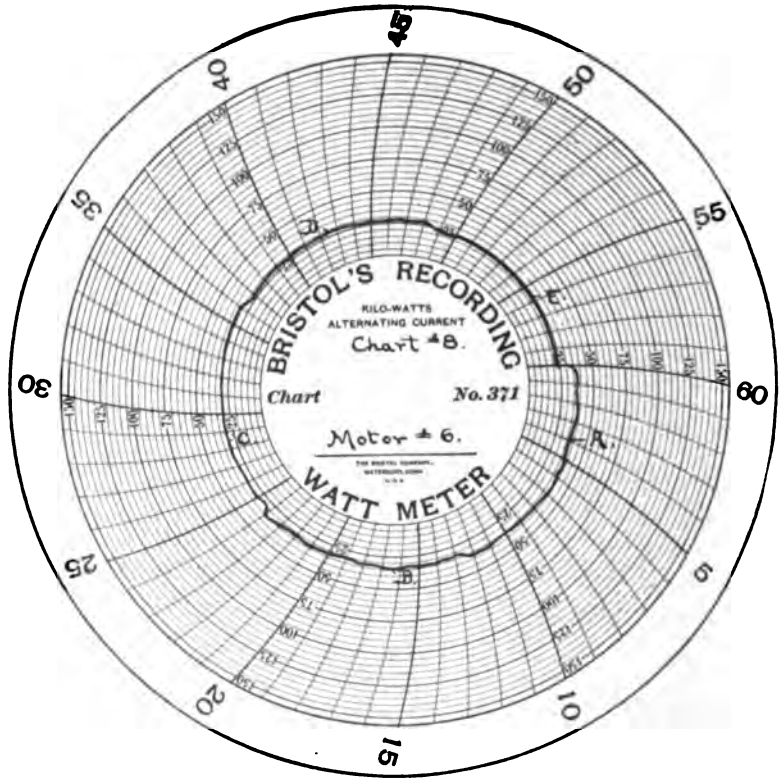


CHART NO. 8.

For motor No. 6; 50 horse power and drives from both ends. Test made Dec. 3, 1904, 4 to 5 P. M.; temperature outside 59.5, inside 74. This motor drives one hundred and twelve looms, as follows:

TABLE NO. 1.

6	26 inch medium,	120 picks per minute.
18	37 " heavy,	120 " " "
15	37 " medium,	120 " " "
2	36 " heavy,	120 " " "
1	36 " medium,	120 " " "
58	46 " light,	140 " " "
12	44 " light,	150 " " "
112		

TABLE NO. 2.

76 looms,	48.1 H. P.	=	.68 H. P. per loom.	
59 "	44.2 "	=	.75 " "	
42 "	39.0 "	=	.92 " "	
21 "	35.1 "	=	1.67 " "	
	29.2		or 60 per cent. for friction load.	

TABLE NO. 3.

76 looms,	48.1	—	29.2	18.9	=	.25 H. P. per loom.
59 "	44.2	—	29.2	15.0	=	.25 " "
42 "	39.	—	29.2	9.8	=	.23 " "
21 "	35.1	—	29.2	5.9	=	.28 " "
	29.2					

TABLE NO. 4.

48.1	—	44.2	=	3.9 H. P.	=	.23 H. P. per loom.
44.2	—	39.	=	5.2 "	=	.30 " "
39.0	—	35.1	=	3.9 "	—	.19 " "
35.1	—	29.2	=	5.9 "	=	.28 " "

You will notice that 60 per cent. of power used is consumed as friction, but as 32 per cent. of the looms were stopped during the test, it is not a fair test in this case. The looms on this motor weave a wide range of goods, but not so great as looms showed up in tables of Chart No. 7. This motor drives 390 feet of $2\frac{7}{16}$, and 112 feet of $2\frac{15}{16}$ inch shafting; total weight of shafting and pulleys is 14651 pounds; total number of hangers, seventy-eight.

As a whole, this mill cannot be taken as a plant showing the electric drive up to its full advantages, because it was, as before stated, the first mill to have a complete equipment of motors. There have been many changes from the original plans, and there is much more shafting employed than there would be in a mill designed for economy in labor, and with the experience that has come by the continued use of years.

The question arose at the last meeting of the Association as to economy of cost in operating an electric driven mill, and on this subject, it will be observed, that no figures have been given in this paper. We believe we have stated the advantages derived from the use of the electric drive in this particular mill, and the reasons for its installation, which was done at the time of the building of the mill, on account of local conditions. As to whether the counter part of this mill, located where it could be belted or rope driven from a water wheel jack shaft, could be operated more cheaply than at present, the writer cannot say, or whether the cost of installation would be more or less; but he is well convinced that where electricity can be generated on a jack shaft in wheel room, and the *mill owns its own power plant*, that the electric driven mill, under these circumstances, is very desirable.

As to the electric driven mill, where current is generated by steam power, the question as to point of economy, either in installation or operation, is one yet to be presented. We have nothing in facts or figures from any cotton mill plants that lead to the conclusion that the electric drive is as economical as the hundreds of plants running that have modern steam power of the ordinary direct belt or rope drive.

We are seeking information on this point, and hope and trust the interest manifested may be satisfied with the presentation of actual figures by those in a position to give the same.

The PRESIDENT. Is there any discussion upon this paper, gentlemen.

Mr. GEORGE I. ROCKWOOD. I would simply call attention to a point. He says on page 288 on the printed paper,—

"In the foregoing tests the power given as required to operate the shafting and motors was taken when motors were running at their lowest efficiency, and consequently the amount of power required to turn the shafting at speed, without machinery load, is much less than the figures given."

"The inability to obtain the efficiency curves of the motors in question has rendered it impossible to give the actual power to be charged to shafting, except as has been given, which includes all losses in and through the motor."

Mr. PAINE has just said in answer to my question that the losses in the motor on very light load may be quite large, but without having read the paper carefully I do not see the application of the figures; because as Mr. PAINE says, we never run shafting alone in our business.

Mr. SIDNEY B. PAINE. I think the tests given in this paper have been made to satisfy questions asked with reference to power to run spindles without shafting; I think all such tests have been with that idea in view but what the manufacturers desire is the power required to run spindles or cards or a given amount of machinery and the necessary shafting. I agree with Mr. ROCKWOOD, that it is not only impossible to get correct results from such tests, but also that such tests are misleading, for what you desire to know is the amount of power necessary in your engine to run the machinery and the shafting.

Mr. EDWIN H. MARBLE. I have been for some time past interested in the motor drive equipment as compared with the shaft driving. The nearest thing I could find was two mills in the South running about the same production, one with the electric drive, the other with the shaft drive. The electric drive

is by a 20 h. p. motor running the cloth room department. By test it takes about 23 h. p. to run the same amount of machinery by shaft on belt drive.

I have endeavored in correspondence to obtain some actual figures what that 20 h. p. motor really meant, and the party was so interested that he made a visit to the shaft driven mill to obtain results there, and he says he is getting better and evener work with the 20 h. p. motor.

It is pretty hard to get at this from a distance, but the figures show a decided advantage in the department driven by the electric motor; and I know, too, that the cloth room in the mill is a great distance from the motive power, which may account for some of the loss of power.

The PRESIDENT. We will now proceed to the next and last paper of the program, Motor Drive as Applied to Cotton Mills, by MELDON H. MERRILL. Paper read by its author.

MOTOR DRIVE AS APPLIED TO COTTON MILLS.

MELDON H. MERRILL, Boston, Mass.

The subject of electrically driven mills is by no means a new one. In fact, it has been presented before the Association in some of its various phases at nearly every meeting for the past few years. While the papers presented have been carefully and attractively prepared, and the interest has been keen, yet, the writer doubts if the subject has been given the careful consideration and thought by the mill operator that it really demands.

To those unfamiliar with electrical apparatus, there is a general feeling that the entire subject is still enveloped in mystery and unsuited for practical operation; in fact, but little understood even by those engaged in its manufacture. Even after a careful study of some of the technical publications, the impression still remains, and in many cases the reader is more confused than before. This, however, is due entirely to the character of the literature at hand. Unfortunately, there is a woful lack of the proper kind of information in printed form that is suitable for the practical mill man. The busy agent or superintendent has neither time nor inclination to wade through the quantity of technical data and confusing terms found in even the most practical electrical publications, and owing to the lack of clear and concise information on the subject of motor drive as applied to his particular class of work, this very important and, in fact, money earning feature is given but little attention.

Manufacturers of electrical apparatus have long realized the

advantages of motor drive for industrial purposes, and their own shops will be found as a rule, completely equipped with this system. The growth of the industry along other lines, however, such as traction and central station work has compelled their almost undivided attention, thus temporarily forcing the industrial problem aside. This condition, however, does not exist today and the large manufacturers are giving this problem the careful consideration and attention it demands.

It is not the purpose of this paper to go into the minute details of electric drive for cotton mill work, but rather to point out a few of the salient features which should appeal to the practical mill operator.

Industrial establishments have perhaps been somewhat slow to adopt electric drive, due particularly to two reasons. First, electrical apparatus has been considered rather complicated and delicate. Second, the advantages to be gained have not been fully understood. Regarding the first, it would be hard to find at the present day, any power transmitting device approaching in simplicity and reliability, the alternating current induction type of motor. As one user has aptly said, "they are as simple as a grind-stone." These motors are built of two principal parts, the stationary and the rotating elements. As usually constructed, the former receives the current from the generator through its coils which are imbedded securely in an iron core. The current passing through these coils and back to the generator without any break, forming a complete circuit. The rotating part consists of a laminated steel core provided with partially closed slots on its outer face through which insulated copper bars are passed, forming a very simple and substantial winding.

The rotating element is mounted on a shaft which is supported in bearings of large dimensions; these are the only frictional parts in the motor, there being no brushes, commutator, collector rings or moving contacts. The bearings are self-oiling and require no attention other than an occasional inspection and filling the oil reservoir.

This type of motor is very rugged in design both mechanically and electrically and is capable of carrying very heavy overloads for several hours. Motors of this type are built in sizes from a fraction of a horse power up to several hundred horse power, and can be erected on either floor, wall or ceiling, and arranged for either belt or direct drive. Such motors are started and stopped by a simple starting device which may be located at any convenient point near the motor, or at some distance as may be preferred. In some cases, all the motors on one floor are arranged to be controlled from the same station, thus allowing one operator to start quickly, the entire department.

The alternating current generator has been in use for many years and its operation and reliability are too well known to require any detailed description. It is sufficient to call attention to the fact that these generators are built for almost any speed, suitable for direct connection to either water wheels, steam engines or steam turbines. Or, they may be belt driven if preferred. Like the motors, they have a very large overload capacity and are capable of operating for many hours at considerably above their rated output. They are constructed for various voltages or pressures, so that the question of distance between generator and motors need not be given any serious consideration. Having the generator and motor, there remains only the necessary connection between them to complete the installation. This may be divided in two parts; the switchboard controlling the generator and the various circuits or feeders, and the copper feeder wires to the various motors. The former is usually constructed of marble or slate and is located at some convenient point in the generating station. From this board, the generator is controlled and on it the various indicating and recording instruments are mounted, together with the switches controlling the several feeders. The feed wires are of either copper or aluminum suitably insulated, and rigidly secured to the ceiling or wall either by insulators or a conduit system. These wires transmit the electric current from the generator to the

motors and when once in place are as secure and permanent as any piping system, requiring absolutely no care or attention.

There are so many advantages to be gained by electric drive that it would be impossible to consider all of them in a paper of this character. We will, therefore, discuss only a few of the most important. There are many mills originally driven by water power, where, owing to an increase in business, additions have become necessary, and the extra power required, has been obtained by installing a steam engine, thus increasing the cost of production. By using electricity, some other power on the same or an adjacent stream could be developed, transmitting the current to the mill thus saving considerable in the operating expenses. There are also some cases where the water power available is sufficient for a part of the year, but a steam plant has to be kept in reserve for the seasons of low water. In such plants, the engines are obliged to operate at an uneven load, depending on the condition of the water power, thus giving a very poor economy in addition to the expensive and cumbersome arrangement of shafting necessary in order to make the required change from water to steam. With a steam turbine, which operates at a very uniform economy over a wide range of load, this condition would be greatly improved. In fact, the turbine presents several advantages over the steam engine, which may properly be taken up at this time.

This type of prime mover, which has been in use for many years abroad, has but recently been developed in this country, and is meeting with very marked success. It is particularly adapted to drive electric generators and has been used thus far almost exclusively for this purpose. The turbine requires only a fractional part of the space occupied by the Corliss type of engine of equal output, and having no reciprocating parts, requires no foundation. In fact, any support capable of sustaining the weight of the unit, will be found adequate. This allows the condenser and other auxiliaries to be located under the turbine, thus further reducing the amount of space required and affecting a corresponding saving in the cost of the build-

ing. As no internal lubricant is required in the turbine, the exhaust is entirely free from oil, and the condensed water may be returned to the boiler or used for other purposes where hot water free from foreign elements is required. This feature alone is of great importance in the bleaching and dyeing departments.

The economy of the turbine at a constant load compares favorably with the best reciprocating steam engine practise of today and surpasses the latter when operating at variable loads. The generator built for turbine work is also somewhat better as regards efficiency than a machine of similar size for direct connection to a reciprocating steam engine. The efficiency of the turbine outfit is therefore, considerably better than engine type outfit of similar capacity. This together with its simplicity and lack of complicated parts renders the turbine outfit particularly desirable for mill work. In cases as stated above, where it is necessary to use auxiliary steam power, the turbine fulfills all requirements. It is possible in many cases owing to its compact form, to install the unit in the existing engine room, in mills where steam and water power are both used, and, having no valves or exposed moving parts, it requires no attention or care during the period of inactivity, and is ready at a moment's notice to be thrown into service. The repairs and maintenance of this type of apparatus is very low indeed, there being little if anything to get out of order. This is very well illustrated by the recent performance of the 400 K. W. turbine unit at the St. Louis Exposition, which operated continuously for 5½ months at practically full load. On shutting down at the close of the Fair, it was examined by a committee of engineers who found absolutely no wear on any of the blades or bearings.

It is very gratifying to note that the advantages of the turbine are being recognized, and there are already quite a number of textile mills, that have in use or on order, turbine units.

Thus far the advantages considered have dealt entirely with the generating or power plant end of the installation. Considering the mill proper and the distribution of power, the motor drive presents many features not found in any type of belt trans-

mission. It frequently occurs that additions or extensions have to be provided; in such cases, there is a very large expense for shafting, frequently necessitating long and heavy lines which take considerable power and add materially to the friction load. By using motors for the additional power required, this shafting can be avoided and the new buildings may be located so as to obtain any advantage accruing from low cost of land or transportation facilities. The motor drive also allows a better subdivision of power, driving the various departments in proper groups and thus cutting out long lines of distributing shafting. In many cases it is possible to connect the motor direct to the main shaft of a certain group either at the end or in the center. The group drive renders a shut-down from accident to shafts or belts, practically impossible, as such trouble is confined only to one particular group, the remainder of the machines in the same department not being affected. This method also allows the various departments to be operated separately if desired, at no material loss in efficiency. It sometimes occurs that from various causes one department gets behind and over-time work is necessary. In such cases, the department to be operated, is the only one using power and there is no waste due to carrying the shafting load of the other parts of the mill, as would be the case in a mechanically driven plant.

The electric drive makes it possible to keep a very accurate record of the amount of power used and is consequently, a check on the work of the operatives. This was very clearly shown in a paper presented by Mr. THOMAS, at the last meeting. Wattmeter readings indicate that there is a falling off of the power just before the noon hour and again just before shutting down for the night. While the electric drive does not prevent this occurrence, it at least brings it to the overseer's attention, and the proper steps can be taken to correct the loss in production.

Another advantage gained by motor drive is a more uniform speed with a consequent increase in production and fewer breaks, resulting in a better grade of goods; this is a point often overlooked in considering this system. Figures No. 1 and No. 2 illustrate the usual type of group drive.

FIGURE 1.

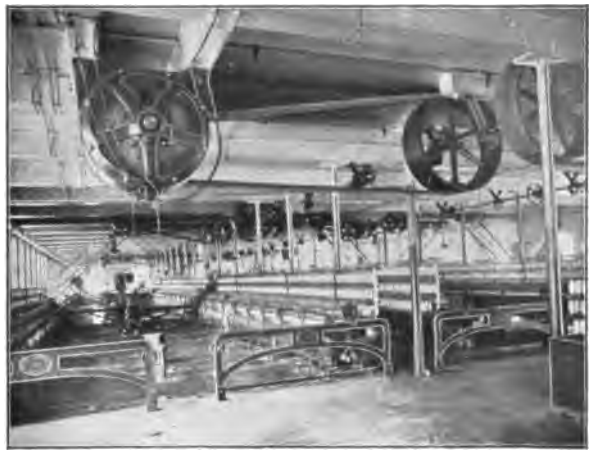


FIGURE 2.

Before closing, the writer would like to call attention to a somewhat different type of drive than that ordinarily adopted for mill work. The foregoing has considered only the arrangement known as group drive, which thus far has been adopted in the majority of cases where electric power has been applied to either new or existing mills, and the advantages mentioned have been based entirely on this type of drive. There are, however, still greater opportunities for improvement with the direct drive or direct connected arrangement as it is sometimes called. In this system, a motor is employed for each individual machine and is so arranged that it is coupled or geared to the main or pulley shaft, there being no belts or pulleys used. In this system all the advantages of the group drive are retained in addition to several others, found only in the direct connected drive. One of these is the great improvement in the lighting of the mill as all belting and shafting is entirely avoided and there are no shadows either by daylight or artificial illumination. This feature alone materially improves the grade of goods, particularly in the weaving department, in mills where the shafting is located on the ceiling rather than on the floor below.

With the direct drive the shafting and belting is not required, which effects quite a saving in the original installation and reduces somewhat the extra expense of installing the direct connected system. With the absence of these parts, there is considerable saving effected in the maintenance and upkeep of the power plant, the cost for maintenance of the motors being far less than that of the shafting and belting. With the shafting removed, much lighter construction can be used with the same factor of safety, and a considerable saving is thus made in the building.

With the individual drive it becomes a very simple matter to determine at any time the exact condition of any machine having a large number of small moving or complicated parts, such for example as a spinning frame. By attaching temporarily a wattmeter to the circuit, the exact condition at any time can be determined, and proper repairs or adjustments made if necessary.

With the belt drive, it is practically impossible to ascertain the condition of these machines and there is always some doubt as to whether or not they are operating at their proper efficiency, this feature is of considerable importance and one that should appeal strongly to the practical operator.

While these features are all important, by far the greatest gain is in the matter of production. It has been found that where the direct connected drive has been installed to replace the belt drive, that there has been an increase in production of from 5 to 7 per cent. At first this may seem rather a broad statement, but a careful consideration will make it apparent. No one questions but that with a given power to transmit, the belt offers a cheap and convenient drive. It is, however, a very variable factor in transmitting power. When new, it is put on fairly tight causing undue strain and friction on the bearings, thus increasing somewhat the amount of power required. As it is used, this condition gradually improves and a point is reached where the strains are not excessive and yet there is no slip and the power is transmitted both cheaply and efficiently. Unfortunately, however, this condition is not permanent. As the belt continues in use, it stretches more and more and finally reaches a point where there is considerable slip and the speed of the driven shaft may be considerably less than that of the driver. This causes no reduction of power to speak of, but a marked decrease in production. This difficulty with the belt drive would not be so serious if the exact condition of each belt was known at all times, and consequently adjusted at the right moment. There is, however, no method of determining this condition quickly and cheaply, particularly where there are hundreds of such drives to be cared for. With the direct connected drive the trouble is entirely obviated. The motor operating at an absolutely uniform speed and maintaining an even constant torque at all times, thus giving a continuous and absolutely steady production. In cases of accident to the motor, only one machine is rendered inoperative, which may be repaired without in any way affecting the remaining machines in the room, and

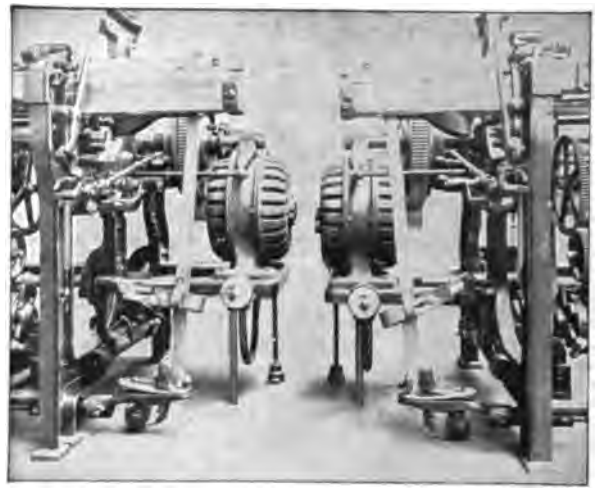


FIGURE 3.

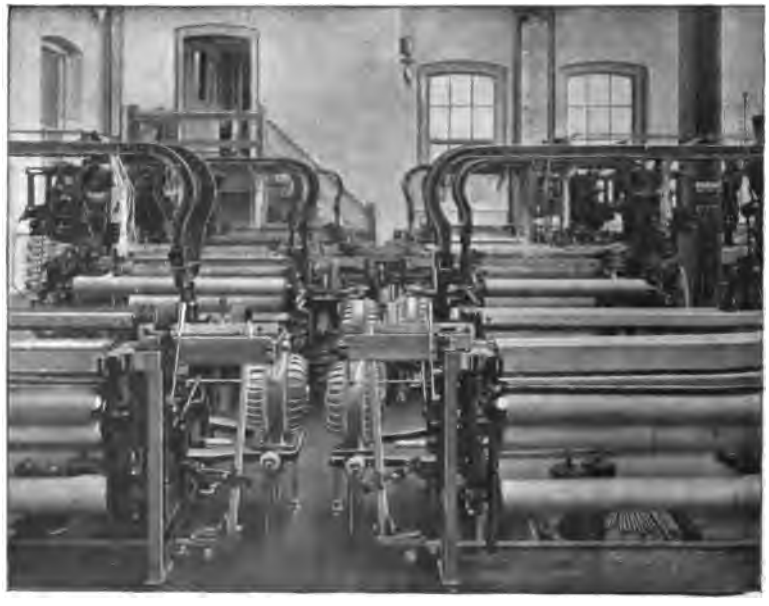


FIGURE 4.

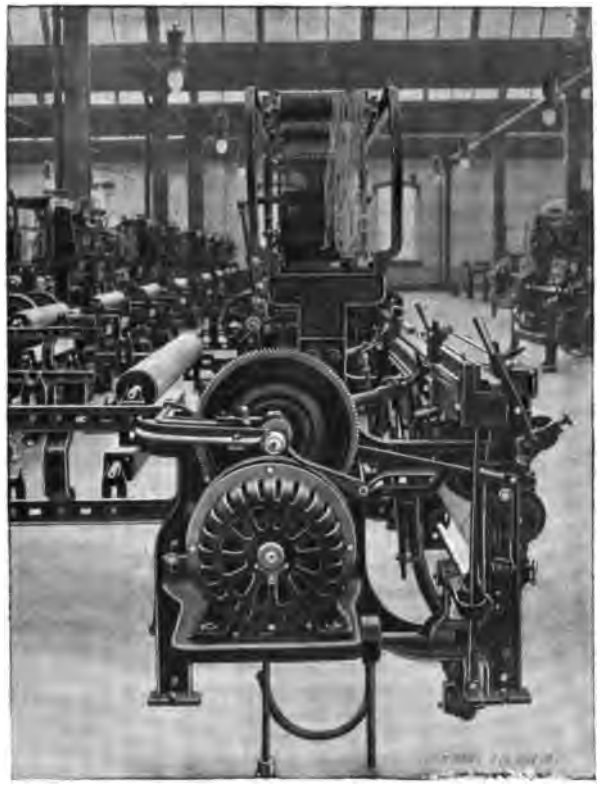


FIGURE 5.

there is no friction load to be maintained during the period of shut down. This is without doubt the ideal system in every respect for mill work, and one that will undoubtedly be adopted more and more as its advantages are considered.

Figures Nos. 3, 4 and 5 illustrate the application of this type of drive, showing ¼ horse power 2-phase, alternating current motors direct connected to looms. Figure 3, indicates quite clearly the details of the arrangement, showing the method of mounting the motor, and also the gear and pinion by which it is connected to the loom. The switch controlling motor will be noted at the bottom of the motor bed plate. Figure 4, is a

photograph of the same installation showing several looms and the general plan of the room. It will be noted that the arrangement is very compact and of pleasing appearance. Figure 5, shows the end view of motor direct connected to a different type of loom.

The point will be raised that the first cost of this system will be so great as to render it prohibitive in every case. It is true that the first cost will be somewhat greater than for an equivalent installation arranged for belt drive. It is not, however, enough greater to warrant its being discarded. Some very interesting tests and comparisons have been made on this subject which may prove of interest. Elaborate tests have been conducted in mills using the group type of electric drive. The shafting and belting has been carefully measured from which the costs have been determined. These costs will of course be less than the cost of equipping a mechanically driven mill; as in the latter case the heavy main driving shafts would have to be included. The cost of the shafting and belting together with the motors has been compared with the cost of a requisite number of individual motors for the same machines. The difference shows the excess of the proposed investment (direct drive) over the present investment (group drive). Interest on this amount at 5 per cent. has been allowed; in all cases this interest charge has been balanced against the saving in horse power at $25.00 per year per horse power, due to the absence of shafting; the differences in motor efficiencies being taken into account. The result shows the saving per year credited to the direct connected drive. Take for example the spinning room in one of the large New England mills; in this mill a 200 horse power motor operates 52 ring spinning frames. The cost of the installation is shown as follows:

Motor,	$2,060 00	
Belts and shafting,	634 00	
Total,		$2,694 00

With the direct connected drive 52 3-horse power motors would

be required at a cost of $5,290.00 leaving a difference $2,596.00 in favor of the group drive. Interest on this amount at 5 per cent. would equal $130.00 per year. It was found from actual tests at the above mill, that 37½ horse power was required to drive the shafting load, no frames being in operation. Taking into account the difference in motor efficiency, we find a saving of 18 horse power by using the direct connected method. Eighteen horse power at $25.00 per year amounts to $450.00 which compared with $130.00, the interest on the increased investment, shows a saving of $322.00 a year, or, that the direct connected drive would pay for the added investment in eight years. Similar figures in connection with the weave room in another mill showed a saving of $277.00. In the above figures, no account has been taken of the saving effected by the reduced cost of maintenance, neither has the increased production been considered.

Regarding this matter, the writer might state that this not an extreme case, it being one mill selected from a large number of tests, and represents an average condition. Of course no case can be decided on general practice, and each will require careful consideration on its own merits. It appears, however, from tests conducted in both northern and southern mills, that ring spinning frames, fly frames, rovers, twisters, slubbers and looms are particularly adapted for direct drive. In carding and picking, the advantages are not so pronounced. It may be said that while the direct drive works out well in theory, it would not hold true in practical operation. In reply to this, the writer can only say that in all cases where the system has been tried, it has been pronounced by the users as entirely satisfactory and has surpassed their expectations in every respect. In fact, this problem today occupies the same position as that of the electrically driven machine tool of about two years ago. It was recognized by all metal workers that the motor drive was convenient and cleanly, but that the excessive cost would render it prohibitive, but when it was proved that the production of their shop could be materially increased by the direct driven tool,

interest was speedily aroused and at the present time, machine tool builders are called upon to furnish about 60 per cent. of their entire product arranged for motor drive. The growth in this particular branch has been something remarkable, and the advantages gained are no greater than those to accrue from the use of this system in textile work.

Already considerable interest is being taken in this matter, and if the growth of this type of drive is as rapid as has been the growth of the group drive as applied to textile mills, it will be but a few years before many thousand horse power will be in operation.

The PRESIDENT. Gentlemen, Mr. MERRILL will, I am sure, be pleased to answer any question you may desire to put to him.

Mr. WALTER E. PARKER. Referring to the paper just read, direct drive or directly connected arrangements for driving machinery I suppose implies that we can do away with all our shafting.

I do not think that that system has been adopted in any mill yet, although the idea is not new; it seems to me that the expense of so many motors would be very large, and the loss in transmission which Mr. PAINE mentioned a few moments ago must be counted for something to offset the power required for driving shafting.

I say the system is not new, for I recall several years ago that Mr. PAINE told us about being able to perhaps drive each spindle with a motor. I would like Mr. PAINE to tell us his experiments in that line, and what he thinks of this direct drive which has been mentioned.

Mr. SIDNEY B. PAINE. Mr. President, I have been quoted many times as being in favor of this idea of driving each spindle with its own motor. Until within two years ago I thought this was entirely visionary, but I confess that I have seen a machine within the last year which I think is one of the most ingenious devices ever gotten out. In this machine each spindle does have its own motor. I refer to the "cocoon spinner," so-called. In this machine some of the most objectionable parts of the spinning frame are eliminated, such as the banding, rings and travellers. It has not yet been put in practical operation in a mill, but the gentlemen who are promoting it have strong hopes of being able to overcome all the difficulties which they have met.

In connection with this direct drive, I would say that it is very attractive, and, theoretically, it is the ideal system, but I cannot agree with the writer of the paper under discussion, that it is a practical system.

Seven years ago the Anderson Cotton Mills installed 40 motors driving 80 spinning frames, each motor being placed between two frames to which it was directly connected by friction clutches. That was described in a paper read before this Association six years ago.* Those motors gave perfect satisfaction in every respect, and I think the production from those spinning frames has never been equalled. In spite of this large production, I have not advocated that system to any other mill. The reason for it is that on spinning frames you must have some means of changing the speed; on different counts you must have a method of changing the speed on the drum. This you cannot do with the directly connected induction motor unless you use a slip-ring motor.

Then again, in laying out the drive for a ring spinning room it is incorrect to assume that the spinning frames all take the same amount of power per spindle.

Several years ago I tested one frame of 224 spindles, running 9,200 and spinning No. 28 yarn, with a direct connected motor.

* Transactions, New England Cotton Nanufacturers' Association, Vol. 66, p. 327.

The power required was about 2½ h. p. Within six months I tested another frame apparently absolutely identical with the first, and it took over 5 h. p. Examination showed that the bands were extremely tight, and that the gears were filled with lint and dirt.

In laying out a direct connected drive we must provide for the maximum duty which that motor is to perform; therefore, the motor must be large enough to drive spinning frames under the worst conditions. Under the group system of driving you take advantage of average conditions of the average number of frames run at one time, and the total horse power capacity of the motor ought to be less in a group to do the same work than in the direct connected system.

Reference has been made to the machine shop as an illustration of the advantages to be derived in a cotton mill by the adoption of the direct system. The machine-shop adopted it for two reasons, — in the first place the machinery is in operation at infrequent intervals and intermittently. With the group system, under those conditions, it would be improper to have a motor not large enough for all the machines, and yet it would be difficult to determine the proper size of motor to be used. In the direct system a motor is used capable of doing the work for that machine only. The generator to drive the motors of a machine-shop has to be only 35 per cent. to 45 per cent. of the aggregate capacity of all the motors connected with it. That shows how infrequent the service is. Another reason for the adoption of the direct system in a machine-shop is on account of the variable speed on the tools, and it is here that a great saving has been made; for in cutting a shaft they can change the speed of rotation so that the cutting speed is maintained constant. On the planer the same plan is followed, the speed being determined by the cut. But for such purposes a continuous current motor is used, which I consider is unsuitable for cotton mill driving, and has not been used successfully up to the present time on cotton work. The majority of the silk looms in this country which are electrically driven are operated

by a motor to each loom; for instance, the Royal Weaving Company in Pawtucket has over 400 of those motors, each running its own loom.

Why then has this direct system not been more generally adopted? The cotton mill is very different from a machine-shop, in so far as the proportion of machinery in operation is concerned. In the paper read today I showed to you that an average of 95 per cent. of the spinning-frames were running for that entire week.

In the paper under discussion reference is made to a test of a 200 h. p. motor operating 52 frames by the group system. The friction load is stated to be 37½ h. p. This evidently included the losses in the motor, for under similar conditions, in the series of tests which were described in the paper which I have just presented, we found that 34.9 h. p. as a maximum was required to run the motor driving the shafting and belting only.

I have already endeavored to show in answer to Mr. ROCKWOOD'S question, the error of assuming that this represents the friction load; and for the purpose of determining the relative values of the group and direct systems of driving, it is manifestly improper.

The test referred to in my paper showed an average of 73 spindles per horse-power, including shafting and belting. On that basis the 200 h. p. motor would have driven 65 frames without being loaded beyond its rated capacity. If a 3 h. p. motor were sufficient to drive each frame under average conditions, 65 such motors would have been required by the direct system, (with the strong probability that such motors would be seriously overloaded at times) to drive the same number of spindles, instead of 52 motors as was suggested by the writer of the paper under discussion.

Up to within a short time the first cost has been a more serious item than it is at present, but obviously as the price of induction motors is reduced the relative value of this item becomes less, for the cost of the shafting and belting with the

group system remains the same. A large proportion of the cost of the belting used on the group system is eliminated when the motor is directly connected to the spinning shaft. This is the plan followed in the most recent installations.

It has been suggested that the direct system is preferable for the weave-shop, and that each loom should have its own individual motor. As has been stated before, every motor must have sufficient capacity for the maximum duty. The power required for different classes of looms varies very materially. You have the narrow and the wide loom, the plain and the fancy, Jacquard, Bobby and the Draper loom, each requiring a different amount of power. Assume that ⅓ h. p. motor would be the average size to be used; in a weave shop of, say, 2,000 looms the first cost of 2,000 ⅓ h. p. would be at least $80,000, this sum covering the wiring and installation; three 150 h. p. motors would be sufficient if the group system were used. The cost of three 150 h. p. motors installed would be less than $5,000. For the difference between these two sums you can equip the entire mill in question by the group system, and install the generator, the motors for all departments, the switchboard, exciters, and wiring, and also furnish a complete lighting system. When you bear in mind that the $80,000 referred to covered only the motors and wiring for 25 per cent. of the power required, and did not cover any generators, switchboard, or exciters, the saving in first cost resulting from the use of the group system is very apparent.

Mr. DANIEL MOORE BATES. While on the subject of motor drives it might not be out of place to ask the question whether anything has been done in this connection in bleacheries. I do not know, but ask for information.

It is a fact that in the bleachery we have a great deal of trouble, as all bleachers know, with dirt from the belts, and with oil from the shafting, and no matter what you put up to protect the work there is more or less grease off the belts.

Now, is it feasible to drive a bleachery with motor drives, or

does the wetness in the bleachery preclude the possibility of such a use of that drive? I would like to know what the consensus of opinion is on that question.

Mr. SIDNEY B. PAINE. In almost every one of the colored goods mills which is using the electric drive; motors are used to drive the dye-houses, which would come somewhat under the class suggested. There they have not attempted to use the individual drive, for the reason that the steam and water would be very detrimental to the direct connected motor, if it were located immediately in the dye-house proper. Therefore, they have had to put up with a good many annoyances in order to have the motor outside of the influences of the steam.

But the motor can be made entirely closed, if you desire, and so protected from water or steam that no damage would result and under those conditions it would be practicable to have the motor directly connected to the machines driven if it were otherwise desirable.

Mr. DANIEL MOORE BATES. Of course, if you do not have the motors individualized to a certain extent you have the belts and shafting, which are the objectionable features. And then again, in the bleach-house it is necessary to arrange things so a certain set of reels start up with their machine in the processes of washing or scouring—and if the machine stops it is apt to injure the goods; so it is rather a nice problem to decide how to use the individual motor.

Mr. FRANK B. PERRY. Mr. MERRILL has called attention to the use of the steam turbine as a prime mover in connection with alternating current generators and motors for operating mills with good economy. At the present time the writer has knowledge of 14 steam turbines of different types, aggregating 9,600 Kw. capacity, or the equivalent of 14,400 I. H. P., the units varying in size from 400 Kw. to 2,000 Kw. each, that have been purchased for the operation of cotton mills. About 50 per cent. of these have been started and are in daily service.

In view of the recent rapid development of the turbine as a practical prime mover this is decidedly encouraging, and indicates the keenness of the cotton manufacturer in recognizing the merits of this type of apparatus as being especially well adapted for his class of work.

The turbine may be designed for low steam pressure, and successfully applied to operate in conjunction with several non-condensing reciprocating engines delivering steam at slightly above atmospheric pressure. Under these conditions the turbine would operate condensing, and thereby increase the total output of the plant with a net gain in economy. The relative cost for changing the engines for condensing operation and that of the turbine equipment, together with their dependent factors, are taken into consideration in making the above comparative statement. In some types of turbines, steam may be diverted from the earlier stages at any pressure required for heating purposes. The energy of the steam given for heating is, by this method a comparatively small percentage of the total amount required for the rated capacity of the turbine. This in itself is a valuable feature for consideration.

With regard to the application of motors to individual machines in a cotton mill, it is my opinion that Mr. MERRILL is over enthusiastic in his suggestions for improvement over the methods ordinarily used. Where 90 per cent. or more of the machinery is in operation at all times, as is usually the case in a well-managed cotton mill, it has been my experience that the group system of driving is more efficient. This is especially true for the modern weave shed where the frequency of stoppages is perhaps greater than in any other department. With the looms belted from below, and shafting operated by means of large units, say, of from 50 h. p. to 200 h. p. in size, planned to take care of the average load conditions at nearly full rated capacity, we have a drive which for efficiency and uniformity of speed is difficult to excel.

Some belting is essential for flexibility, and it has been our experience that a motor geared to a loom is not a desirable

arrangement, except under certain special conditions, as for example, in silk manufacturing. The quick starting necessary for bringing a loom up to speed puts rather severe strains upon the motor even though a friction clutch be used to diminish their effect. A weave shed containing 2,000 forty-inch looms on plain and fancy goods may be operated with four or five large motors aggregating not over 450 h. p. capacity. The total capacity in motors for the individual drive consisting of 2,000 of ¼ h. p. each will be 500 h. p., or at least 50 h. p. in excess of that actually needed. Furthermore, the expense of attention, maintenance and repairs to these small motors and their gearing would be considerably more than needed by the larger motors with shafting and belt connections.

As applied to spinning frames, complications at once arise in providing suitable means for altering the cylinder speed when so desired. The spinning-frame drive at the Anderson Cotton Mills, described by Mr. PAINE* in his paper entitled, Electrical Driving, Fallacies and Advantages, is an exception, for the reason that the spindle speed is never changed, and yarn of one size and quality only is produced.

The example mentioned by Mr. MERRILL in comparing the costs for group and individual systems of driving in a spinning-room is apparently based on incorrect data and assumption. If it requires a 200 h. p. motor to operate 52 ring spinning frames, it is certain that fifty-two 3 h. p. motors aggregating only 156 h. p.will not do the work when applied individually. We should think from our experience that a 4 or 5 h. p. motor would more nearly fulfil the requirements.

The shafting load mentioned, namely 37½ h. p., is excessive for the stated number of frames driven, and would indicate some unusual condition. From a large number of tests made under my supervision we found the maximum shafting load with 200 h. p. motor driving through two main belts to shafting 52 ring spinning frames, aggregating 11,648 spindles, to be 34.9

* Transactions New England Cotton Manufacturers' Associaltion, Volume 66, Page 319.

electrical horse power and when connected to the shafting by two flexible couplings driving 44 frames, aggregating 11,264 spindles, to be 26.8 electric horse power. In both cases the losses in the motor, which was operated at very low efficiency, are included. the actual motor output for driving the shafting being considerably less.

From the varied character of the tests which we have made, and from our long experience in driving mills electrically, we do not agree with Mr. MERRILL in his belief that practically all classes of cotton machinery "are particularly adapted for direct drive."

The machine shop with its variable and intermittent load and poor load factor is an entirely different problem, and not comparable with the conditions met with in the modern cotton mill.

Mr. MELDON H. MERRILL. Referring to Mr. PARKER'S remarks: It is of course true that the expense of a large number of small motors would more than equal the cost of a few large motors. It is also true that the loss in these small motors must be taken into account as well as the loss in the larger motors, and also the losses in shafting. This you will note, has been done in the test mentioned in the paper.

While the cost of the small motor or individual drive would be more than the group drive, the advantages to be gained by the small motor drive are considerable, the most important of which is the increase in production which can be obtained. This we have found varies somewhat, but as stated in the paper there seems to be from 5 to 7 per cent.

Referring to cocoon spinner which Mr. PAINE mentions, this, of course, is carrying the application of the individual motor one step further and if a satisfactory arrangement of this description can be obtained, it will of course obviate entirely one of the principal troubles of the ring spinning frame, *i. e.*, the slip between the drum and the whirl.

We are very glad that Mr. PAINE mentions the installation at

the Anderson Cotton Mills where forty motors were installed driving eighty spinning frames. Mr. PAINE has stated that the motors give perfect satisfaction in every respect aad the production in these frames has never been equalled, which appears to bear out our statement that the production when using direct connected drive can be materially increased.

Another point brought out by Mr. PAINE in connection with this mill, *i. e.*, the different power required to do apparently the same work is one of the strongest reasons why the individual drive should be adopted. You will note that Mr. PAINE states that a certain frame of 224 spindles requires 2½ horse power to drive it and within six months another frame was tested which was apparently identical with the first and it took over 5 horse power and examination showed that the bands were extremely tight and gears were filled with dirt and lint. If this frame had not been tested separately, this condition would not have become known.

With the individual drive having one motor to each frame, it becomes a very simple and easy matter to test any frame in a moment's time with a portable wattmeter, thus the actual conditions of each and every frame in the mill can be ascertained readily and abnormal conditions immediately corrected. With this type of drive, a small receptacle should be provided at each motor whereby a wattmeter could be plugged into the circuit temporarily at any time and the readings just mentioned taken without in any way interferring with the continuity of service. This the writer believes is second only in importance to the increased production which it is able to secure with the direct driven frame.

In a large mill driven by shafting there are, without doubt, many frames in operation where conditions obtained are similar to those found by Mr. PAINE in connection with this second frame which he tested and it can be readily seen that if the power is doubled, as it was in this case, that with many such frames in operation, the engine would be called upon to deliver more power with a consequent reduction in speed which would curtail the production of the entire mill.

It is true that in laying out the drive we must provide for the maximum duty which the motor is to perform and the motor must as Mr. PAINE states be large enough to drive the frames in their worst conditions. Fortunately, however, the induction type of motor meets these requirements, it being capable of withstanding overloads of 50 per cent. for one or two hours and 100 per cent. overload for a short time without in any way injuring the motor. This objection to the individual drive, therefore, amounts to nothing.

Reference has been made by Mr. PAINE and Mr. PERRY to the machine shop which was cited as an illustration of the advantages to be derived in the cotton mill by the adoption of direct drive system. Manifestly it was not my purpose in citing machine tool drive as an example of direct drive to compare this with cotton mills as regards the manner of operation. Any one at all familiar with machine tool practice knows that the machines are in use only a portion of the time, but taking all this into account, if machine tool builders are able by motor drive to increase the production of certain tools when operating no more hours per day than when it was driven by a belt, manifestly the same conditions should hold true for textile or any other class of work. The principal advantages to be gained in machine shops by use of direct drive is that in working the same number of hours per day, and with the same class of help, they have been able, owing to the more uniform speed obtained by use of the direct drive, to increase their production materially, and the same will also hold true in connection with the textile industry.

Referring to the test mentioned in the speaker's paper, would state that the efficiency of the 200 horse power motor, and also the efficiency of the smaller motors to replace it were taken into account and the 18 horse power saved, represents the net gain by using the small direct connected motors, taking into account all differences in efficiency and also all losses which, as stated, represents at $25.00 per year per horse power, $450.00.

Regarding the objection which Mr. PERRY has raised in con-

nection with changing the speed on a different count and also the question of changing the drum, we would like to state that this matter has already received attention and simple means provided in order to overcome this difficulty.

Regarding Mr. BATES' inquiry in connection with using motors for bleacheries, we would advise that this has already been done to quite an extent, and there are now a number of bleacheries in New England which are partially or wholly driven by electric motors. In some cases where the steam is very bad, it has been found necessary to suitably protect the motor from this element particularly if the same is laden with acid fumes, it does not, however, to-date, present a very serious difficulty, and it is one which can be readily overcome.

Regarding the point brought up by Mr. PERRY concerning the flexibility of the direct drive, in which he states he does not consider it advisable to connect the motor direct to the loom on account of the quick starting which puts severe strains on the motor, we would state that we have made a large number of experiments with small induction motors of the squirrel cage type, direct-connected to the looms, in which it has been found in every case that the motor will start the loom on the first pick even when direct connected by gear and pinion and without the use of friction clutches or devices of any sort, and then without undue strains on the motor.

Regarding the point brought up by Mr. PERRY that the test as cited in the paper is based on incorrect data, would state that we are surprised, to say the least, to hear an expression of this kind from any one connected with the electrical business. It is a well known fact in connection with commercial testing that electrical readings can be conducted with much more accuracy and to a greater degree of perfection than either by hydraulic, steam or mechanical readings, and in the case cited in the paper, instruments were calibrated both before and after the test in order to avoid all possibility of error.

In conclusion, would state that it was not our intention or purpose to recommend the direct type of drive in each and

every installation. As stated in the paper, each case would have to be decided on its own merits and the drive should be an application of whatever best suits the local conditions. We do believe, however, that the general subject of direct drive is not given the careful attention by mill men that it really demands and if the matter were more thoroughly and carefully looked into, a larger number of mills would be equipped with this type of drive.

We have already conducted a large number of experiments in connection with this work, and the Westinghouse Company, with whom the writer is connected, would be very glad indeed to have prospective users or others interested in this matter avail themselves of such data as we have been able to prepare.

INDEX.

A

Active Members, Election of . . 125
Active Members, List of 14
Additional Top Stripper, Batten and Hayes, On Revolving Flat Card, William Hayes, ... 220
Advertising Income 114
Alphabetical List of Members . 9
Alternating Drive 315
Amendment to Constitution . . 70
Amendment of Constitution for Directors 104
Amendment on "Duties of Directors" 116
American Cotton Manufacturers Association 118
Anderson Cotton Mills, Electric Driving 329
Annual Meeting, April 27, 1905, Members present 63
Arkansas Laws on Trust 151
Associate Members, Election of . 127
Associate Members, List of . . . 32
Association Medal, Award of, Henry G. Kittredge 100
Association Medal Fund 112
Auditor's Report, C. F. Roberts 113
Automatic Stokers 252
Ayer, George A., Elected as Vice President 122

B

Bags 160
Bates, Daniel Moore, Chairman Committee on Distributing and Collecting Ballots 121
Bates, Daniel Moore, Gray Goods for Clay Filled Work 159
Bates, Daniel Moore, Member Committee on Collecting Ballots 117
Barber Warp Tying Machine, E. W. Thomas 225
Batten and Hayes Additional Top Stripper on Revolving Flat Card, William Hayes 220
Bequest of George W. Weeks . . 104
Board of Government 10
Boiler House Construction . . . 256
Boiler Plants in Bleaching and Dyeing Mills, George 1. Rockwood 245
Breaking Strength and Waste . 171
Bronze Statue, Presented to Mrs. Woodbury 97
Brushing Machine 203
Bryant, C. B., Secretary and Treasurer of American Cotton Mfrs. Association, Communication from 117
Burgess, Robert, Chairman of Committee on Nominations . . 76
Burghardt, John H., Member of Committee on Balloting for Members 124

C

Cadwell, William H., Member of Committee on Distributing and Collecting Ballots 121
Call to 78th Meeting 70
Cards, Output of, William Hayes 222

Charter 3
Chimney, Location of 246
Classification of Color, A. H. Munsell 135
Cleaning Machine 211
Cleaning Machine for Cloth Room 211
Clock, Presented to C. J. H. Woodbury 97
Cloth Room and Its Equipment, Edwin H. Marble 198
Coal Pockets 251
Coal, Spontaneous Ignition of, C. J. H. Woodbury 258
Collateral Legacy Tax, Association Freed from 106
Color, New Classification of, A. H. Munsell 135
Color Sphere 138
Color Tree 141
Columbia Duck Mills, Schedule of Machinery 294
Columbia Mills, Power Required by 281
Columbia Water Power 282
Combing Machines, John W. Nasmith 183
Committee on Nominations . . . 76
Constitution 4
Constitution and By-Laws . . . 5
Construction of Boiler House . . 256
Continuous Power Curves . . . 266
Cost of Power 248
Costs of Cotton Production . . . 152
Cotton Production, Costs of . . 152
Cox, Thomas G., Chairman Committee on Balloting for Members 124
Critical Analysis of the Detaching and Piecing Processes in Combing Machines, John W. Nasmith 183

D

Dana, Philip, Static Electricity Neutralized 146
Dennett, Charles W., Shades of Color 145
Dennett, Charles W., Chairman Committee on Collecting Ballots 117
Detaching and Piecing Processes in Combing Machines, Critical Analysis of, John W. Nasmith 183
Dimensions to Define Color . . 139
Directors, Duties of 116
Directors, Duties of, Constitutional Amendment 71
Draper, George Otis, Member Committee on Nomintions . . 76

E

Eaton, Russell W., Variation of Power Required 279
Economizers 254
Education of Corporations, Herbert E. Walmsley 94
Electric Drive, Progress in the Development of, Sidney B. Paine 261
Electric Drive of Cotton Mills, Meldon H. Merrill 315
Electrical Measurement of Power Required in Manufacturing Heavy Cotton Goods, Louis I. Guion 281
Experiments in the Manufacture of Cotton Yarn, Stephen E. Smith 168

F

Fernley, John A., Electric Power 279
Financial Table 115
Firth Scholarship 72
Former Officers of the Association 11
Frothingham, Hon. Louis A., Welcome to the Association . 77

G

Geographical List of Membership 39
Gray Goods for Clay Filled Work, Daniel Moore Bates 159
Guion, Louis I., Electrical Measurement of Power Required in Manufacturing Heavy Cotton Goods 281

H

Hall Clock, Presented to C. J. H. Woodbury 97
Hartshorne, William D., Color Determined 144
Hartshorne, William D. Elected as Vice President 122
Hartshorne, William D., Spontaneous Ignition of Coal 257
Hartshorne, William D., Steel Pockets 257
Hayes, William, Batten and Hayes Additional Top Stripper on Revolving Flat Card 220
Heilmann Comber 133
Honorary Members, List of . . 14
Horse Power of Electric Drive . 262

I

Influence of Mill Ventilation, Eben C. Willey 175
Inspecting Machine 213
International Committee of Master Cotton Spinners 77

K

Kent, George E., Memorial of . . 59
Kittredge, Henry G., Acceptance of Association Medal 100
Kittredge, Henry G., Recipient of Association Medal 100
Knight, S. A., Chairman of Association Medal Committee . . . 100
Knotting Machine 227

L

Laws on Trusts, Arkansas . . . 151
Levy, Abraham A., Recipient of Student's Medal 103
Library Fund 104
Library Fund 112
Life Members 4
Life Members, List of 14
Life Membership 103
Life Membership Fund 112
Location of Membership 58
Loftus, William H., Election as Director 122
Lyall, William L., Member of Committee on Distribnting and Collecting Ballots 121

M

McArthur, Robert E., Member of Association Medal Committee 100
MacColl, James R., Address as President Elect 130
MacColl, James R., Elected President 122
Machinery, Schedule of, at Columbia Duck Mills 293
Manufacture of Cotton Yarn, Experiments in, Stephen E. Smith 168
Manufacturer and Planter, Relationship Between, Theodore H. Price 151
Marble, Edwin H., The Cloth Room and Its Equipment . . 297
Marble, Edwin H. Motor Drives 311
Meadows, William Ransom, Recipient of Student's Medal . . 103
Measuring Machines 212
Measuring Machines 218
Mechanical Draft 255
Members, Election of 124
Members, List of 15
Members Present at Annual Meeting, April 27, 1905 67

Membership Chart, ... 107
Membership, Number of 38
Membership, Totals 106
Merrill, Meldon H., Electric Drive as Applied to Cotton Mills . . 316
Merrill, Meldon H., Remarks on Individual Motor Drives . . . 329
Mill Ventilation and Its Influences, Eben C. Willey 175
Milliken, Roscoe S., Elected as Director 122
Mills Using the Electric Drive, . 262
Montgomery, J. R., Carded Sliver 224
Montgomery, J. R., Loss of Power in Transmission 279
Moore, Joseph Etheldred, Recipient of Student's Medal . . . 103
Motor Drive as Applied to Cotton Mills 313
Motors at Columbia Mills 281
Motors, Direct Connected . . . 321
Munsell, A. H., A New Classification of Color 135
Munsell, A. H., Vote of Thanks to 145
Munsell Photometer 137

N

Nasmith, John W., Critical Analysis of the Detaching and Piecing Processes in Combing Machines 183
Necrology for Year 106
New Classification of Color, A. H. Munsell 135
Nominating Committee 121

O

Officers, Election of 75

P

Paine, Sidney B., On Electric Driving 327
Paine, Sidney B., Progress in the Development of the Electric Drive 261
Parker, Walter E., Electric Driving 328
Parker, Walter E., Member of Association Medal Committee 100
Periodicals on File 109
Photometer for Color 145
Planter and Manufacturer, Relationship Between; Its Antagonisms, Theodore H. Price . . . 151
Plunkett, Charlest T., Elected as Director 122
Power Charts of Columbia Duck Mills 297
Power, Cost of 248
Power, Distribution of, at Columbia Duck Mills 291
Power, Electrical Measurement of, Required in Manufacturing Heavy Cotton Goods, Louis I. Guion 281
Presentation of Testimonial to C. J. H. Woodbury 97
Price, Theodore H., Relationship Between the Planter and Manufacturer; Its Antagonisms . . 151
Proceedings 63
Programme 73
Progress in the Development of the Electric Drive, Sidney B. Paine 261

R

Relationship Between Planter and Manufacturer; Its Antagonisms, Theodore H. Price 150
Report of Committee on Association Medal 101
Resolution of Thanks to Herbert E. Walmsley, by S. A. Knight . 128

Revolving Flat Card, Batten and Hayes, Additional Top Stripper on, William Hayes 220
Robets, C. F., Auditor's Report . 113
Rockwood, George I., Boiler Plants in Bleaching and Dyeing Mills 245
Rockwood, George I., Electric Power 313
Rockwood, George I., Electric Power Curves 278
Rockwood, George I., Member Committee on Balloting for Members 124
Royal Weaving Company, Electric Driving 331

S

Sanford, Pardon B., Member of Committee on Nominations . . 76
Secretary's Report, C. J. H. Woodbury 100
Sewing Machine for Piecing Up . 199
Shade Goods 162
Shafting, Weight of, at Columbia 291
Shearing Machine 207
Sign Cloth 165
Smith, Stephen E., Experiments in the Manufacture of Cotton Yarn 168
Sprague, William, Greater Water Power 282
Stafford, George W., Memorial of 59
Static Electricity Neutralized, Philip Dana 146
Steam Turbines 318
Student's Medals, Award of . . . 103
Students Medal Fund 112
Suit against Executors of Weeks 105

T

Taxation, Association Freed from 106
Taylor, Fred, Recipient of Student's Medal 103
Technical Dictionary 75
Technical Education, Herbert E. Walmsley 93
Testimonial, Presentation to C. J. H. Woodbury 97
Thissell, E. A., Member Committee on Collecting Ballots . . . 117
Thomas' Paper on Warp Tying Machines 225
Thompson, D. M., Member of Association Medal Committee . . 100
Tidd, Joseph S., Memorial of . . 59
Transactions 134
Transactions of File 109
Treasurer's Report, C. J. H. Woodbury 111
Trusts, Arkansas Laws on . . . 151
Tying Machines for Warps, E. W. Thomas 228

V

Value in Color 137
Ventilation of Mills and Its Influences, Eben C. Willey 175

W

Walmsley, Herbert E., Address Presenting Testimonial to C. J. H. Woodbury 97
Walmsley, Herbert E., President's Address 81
Walmsley, Herbert E., Resolution of Thanks to 128
Walsh, James A., Memorial of . . 59
Waste and Breaking Strength . . 171

Weeks' Bequest 104
Welcome to the Association, Hon. Louis A. Frothingham 77
Whitney, Eli, Born at Weymouth 78
Warp Tying Machine, E. W. Thomas 225
Willey, Eben C., Mill Ventilation and Its Influences 175
Woodbury, C. J. H., Acceptance of Testimonial 98
Woodbury, C. J. H., Secretary's Report 102
Woodbury, C. J. H., Spontaneous Ignition of Coal 258
Woodbury, C. J. H., Testimonial Presentation to 97
Woodbury, C. J. H., Treasurer's Report 111

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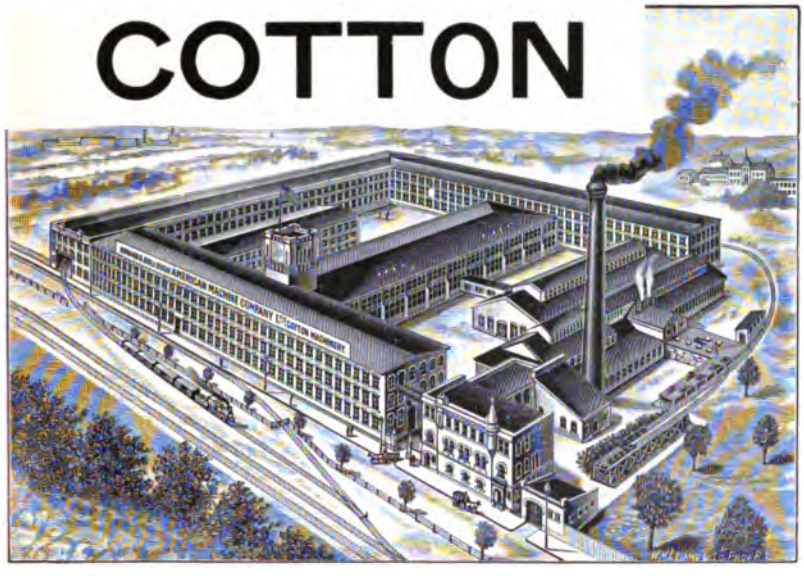

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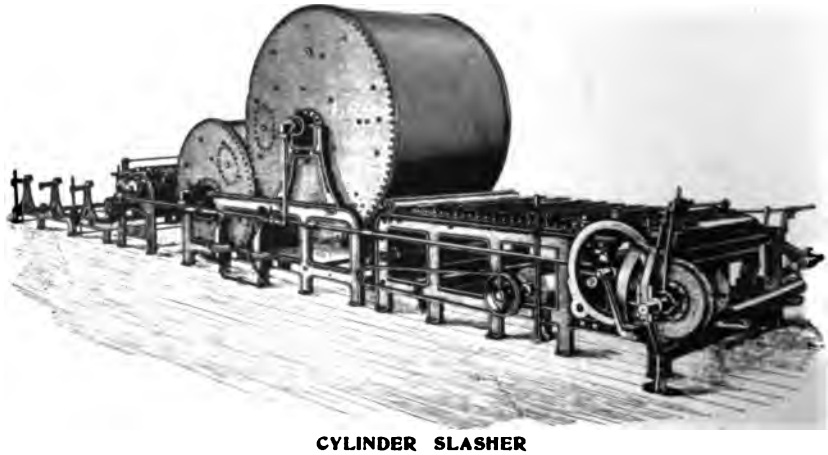

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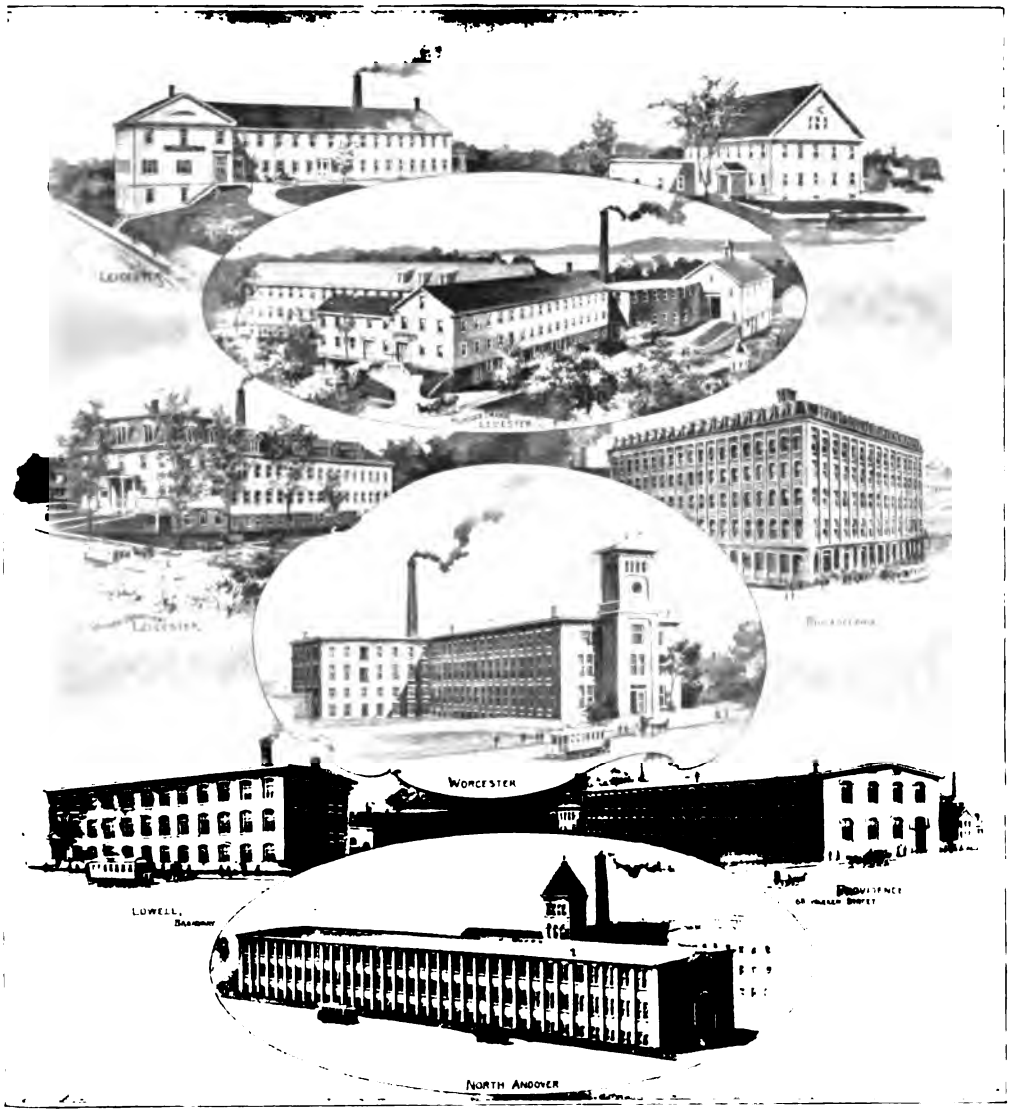

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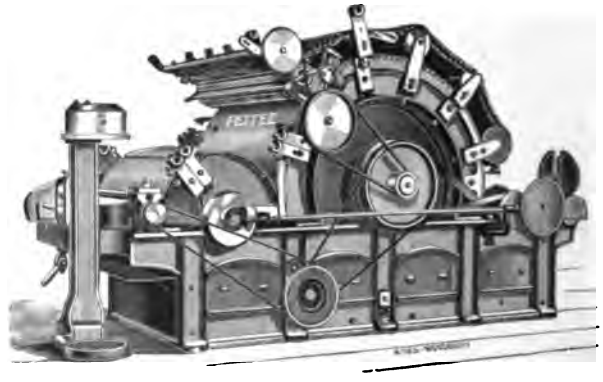

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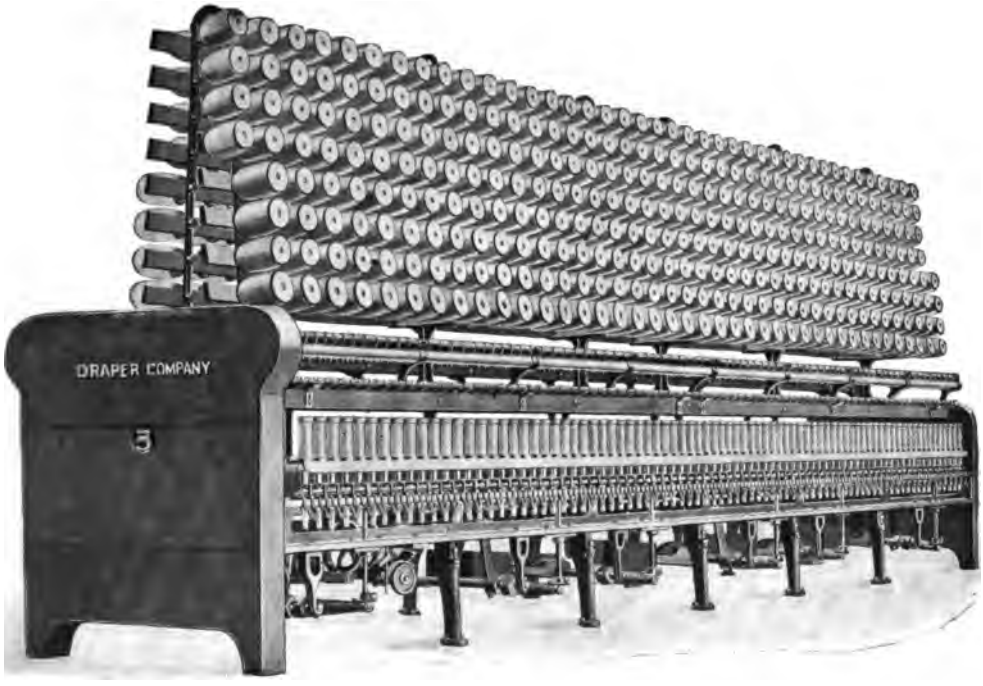

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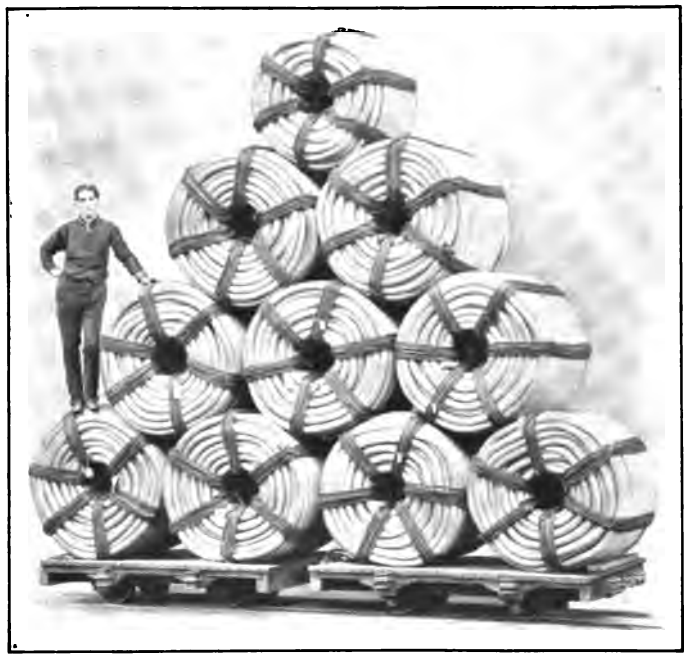

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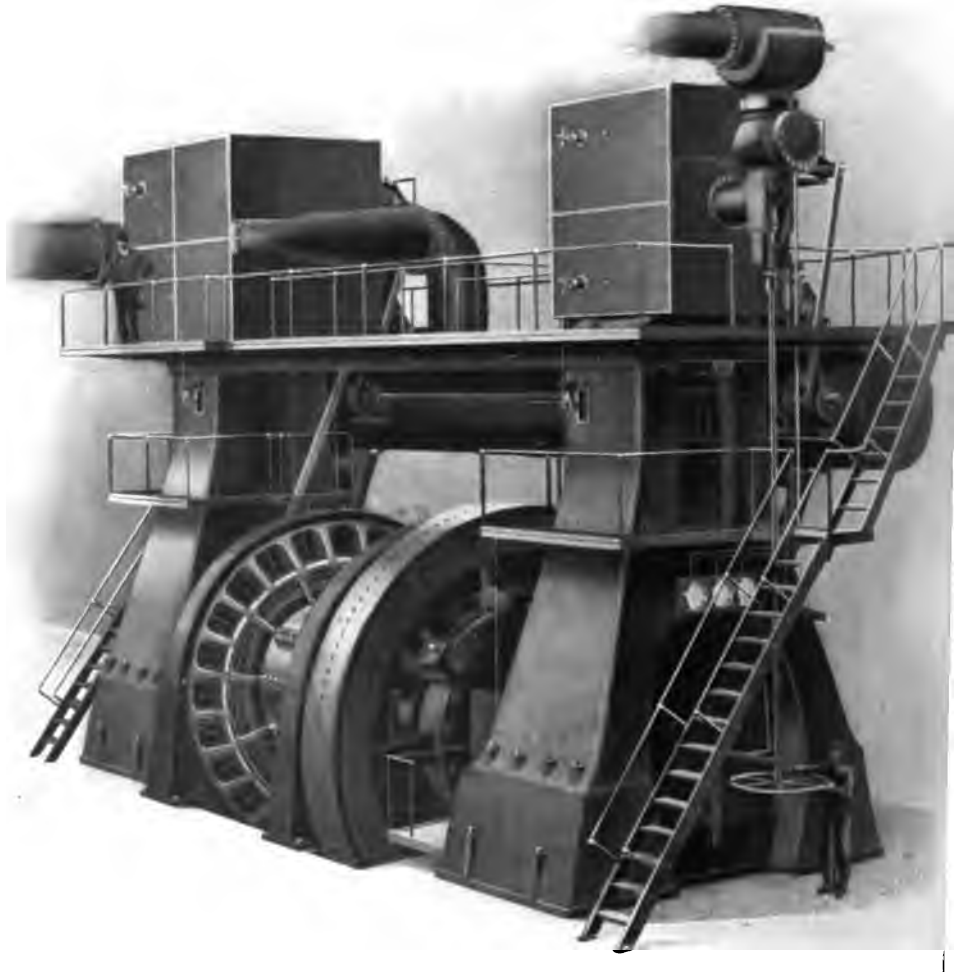

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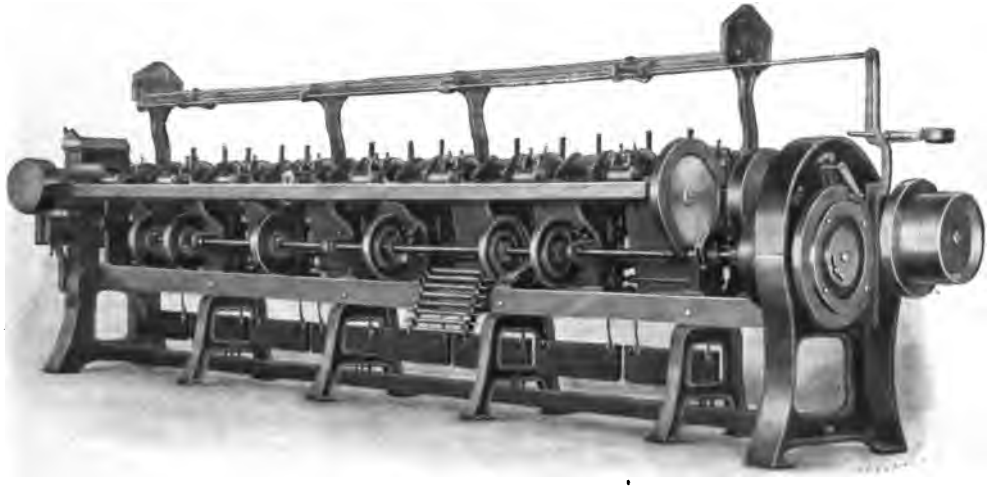

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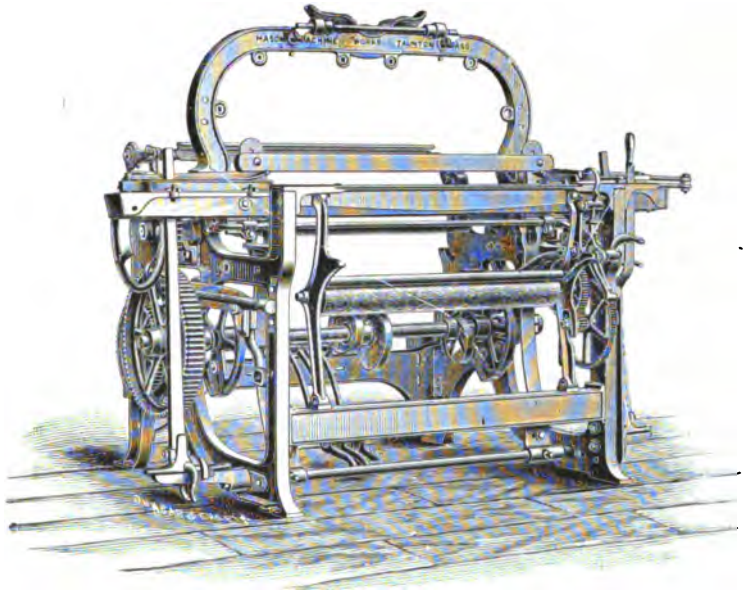

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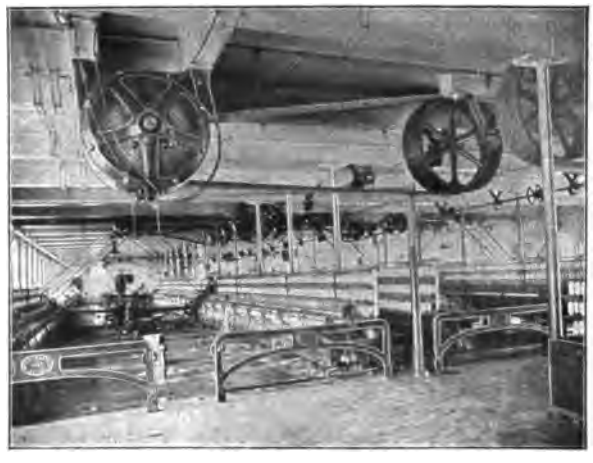

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